THE MODEL ENGINEER

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The MODEL ENGINEER

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31ST AUGUST 1950 VOL. 103 NO. 2571

SMOKE RINGS

Our Cover Picture

● THIS YEAR marks the centenary of the erstwhile Great Northern Railway—a line which, in the pre-grouping days, was one of the best-known and most popular of the English railways. Its locomotive history alone is, at least, as romantic as most, being so closely associated with such men as Archibald Sturrock, Patrick Stirling, Harry Ivatt and Nigel Gresley. These names will be for ever linked with the progress of British locomotive design, for each of these great men has, as it were, carved a niche for himself in the annals of that important and specialised branch of engineering.

Of a number of more or less local events held in honour of the centenary, a special "Great Northern Centenary Express," organised by our contemporary, *Railway Pictorial and Locomotive Review*, was run from King's Cross over the entire route of the original Great Northern Railway on Sunday, July 16th. Appropriately, the train, which was well patronised, was hauled by Class A-1/1 4-6-2 engine No. 60113, *Great Northern*, of the Eastern Region. She carried a special headboard displaying the title of the old company, the centenary dates and a portrait of Edmund Denison, who was the first chairman of the Great Northern Railway and laid the firm foundations upon which the railway's splendid reputation was eventually built up.

We are indebted to Mr. C. R. L. Coles for the photograph from which our cover has been prepared. It was taken during a brief halt at Lincoln.

Overheard at the Exhibition

● A YOUNG lady, carefully examining one of the locomotives in the Competition Section, was heard to remark : "Look, he's put cheese-headed screws in the axlebox keeps !" After that, the exhibit appeared to interest her no more. We mere men should really be more careful !

A small boy was seen to be staring, apparently in astonishment, at the winner of the Locomotive Championship Cup. He made no comment ; but, turning to Col. Billinton's 2-in. scale L.B. & S.C.R. 2-6-0, he said : "I expect a *man* made that."

"Flying Fanny"

● IN THE Loan Section of the "M.E." Exhibition there was a very interesting exhibit that seemed to intrigue many of the visitors. Contrary to what might have been expected from the title, it was not a product of the imagination of a model aeronautical enthusiast. No! It was a 2½-in. gauge 4-4-0 steam locomotive of quite an unprepossessing appearance, though it showed very strong evidence of Swindon influence.

Its builder, Capt. G. S. Brown, is not normally a builder of small steam locomotives; his primary interest is in ships and ship models, and we hope to publish some description of at least one example before long.

"Flying Fanny," however, was built in circumstances which we believe to be unique; the wheels and chassis were made in Melbourne; the motion in Caernarvon and Port Hedland, Western Australia; the boiler in Perth, Australia, and Southsea, and the tender in Chandle's Ford, Hants. All this was because Capt. Brown was then flying on air-routes in Australia, the Near East, Africa and England, and never went anywhere without some of the bits and pieces, just to keep his hand in.

Tyneside Generosity

● WE SOMETIMES hear of the good that our hobby can do, or, at least, claim responsibility for, besides the pleasure and recreation to be derived from the immediate activities in the workshop. We were, however, particularly pleased to learn, just lately that, as a result of three exhibitions organised by the Tyneside Society of Model and Experimental Engineers in recent years, a total sum of £560 has been handed to the *Newcastle Chronicle* "Sunshine Fund." This is a really splendid result, and we should imagine that it must constitute a record. The "Sunshine Fund" looks after the needs of old folks, provides them and many needy local children with trips to the country and seaside, and generally aims at brightening the lives of old and young who are unable to afford little pleasures and luxuries.

There can be little doubt that, on Tyneside, our hobby *is* worth while!

An Outdoor Track for Oxford

● WE WERE glad to learn from Mr. H. A. Giddings, hon. secretary of the Oxford and District Society of Model and Experimental Engineers, whom we met at the recent exhibition at Thame, that negotiations have been completed for renting a plot of ground at Cowley Marsh. Here the Oxford society intends to install a semi-portable multi-gauge track which will be open to the public, at a small charge, on dates which will be made known in due course.

We know that there are several fine locomotives in the society, and the owners of these will, undoubtedly, be looking forward to the prospect of being able to show their paces to the local public. We have often noticed that a passenger-carrying track is a never-failing means of arousing public interest in our hobby, and we wish all success to the Oxford venture.

From a Lone Hand in India

● WE HAVE had an interesting letter from Mr. L. S. Duckworth, who runs a tea factory in Assam, India. He writes:—

"I cannot tell you with what pleasure I look forward to each copy (of THE MODEL ENGINEER), and this is perhaps rather odd as I am not *really* a 'model engineer' at all, being more interested in rather larger affairs. I have been gradually getting fitted up with quite a useful workshop which is mainly used for carrying out such odd repair work in connection with my tea factory as is beyond the scope of the local mechanics.

"Most of my tools are hand tools, but I have a small drilling machine, electrically driven; perhaps, later on, I will send you a photograph, but would first like to have some sort of a model to show up in it!

"The main thing I have built, besides a good many pieces of furniture, is a 20 ft. motor boat with a Hillman Minx engine, which is very successful. Being so far away, thank goodness, from civilisation [*sic*], we have to make do very considerably with the materials at our local disposal, rather than attempt to purchase goods from, say, Calcutta. For instance, wanting a set of 'number' drills, I wrote to an advertiser in Calcutta, last January; they are still (April) on their way here!"

Mr. Duckworth enclosed a cutting from *The Statesman*, a Calcutta periodical, containing an advertisement by Messrs. Marshall, Sons & Co. (India) Ltd., a branch of the well-known Gainsborough firm. It advertises agricultural tractors, and contains a series of five very interesting illustrations depicting the development of the farm tractor from "Great Great Grandfather," a steam tractor of 1876; "Great Grandfather," a fine steam traction engine of 1896; "Grandfather," a petrol-engined tractor, which bears quite a strong resemblance to a steam traction engine and dated 1911; "Father," a very familiar-looking petrol-driven tractor of 1938 to, finally, "Two Sturdy Sons," both of 1950, one being wheeled and the other mounted on "caterpillar" treads. Mr. Duckworth comments that "nobody seems to have probed back as far as the 1876 model, which looks interesting."

He says that he enjoys very much all "L.B.S.C.'s" articles, but will probably never build a locomotive, because a full-size man driving a small-scale locomotive looks ridiculous [!]. He appreciates layouts with trains running *without* human passengers; but in spite of that, when home on leave, he always salutes that signal in "L.B.S.C.'s" garden when passing by in a train.

Calling Mr. G. C. E. White

● WE HAVE received a note from a Mr. G. C. E. White asking us for authentic plans for the construction of a scale model M.T.B. He has omitted to put his address on the note, so we are unable to reply to him. If he should see this paragraph and will send us his address, we shall be very pleased to forward him a copy of our list of drawings in which he will, we think, find some titles that will interest him.

Traction Engine Models at the 1950 "M.E." Exhibition

by W. J. Hughes

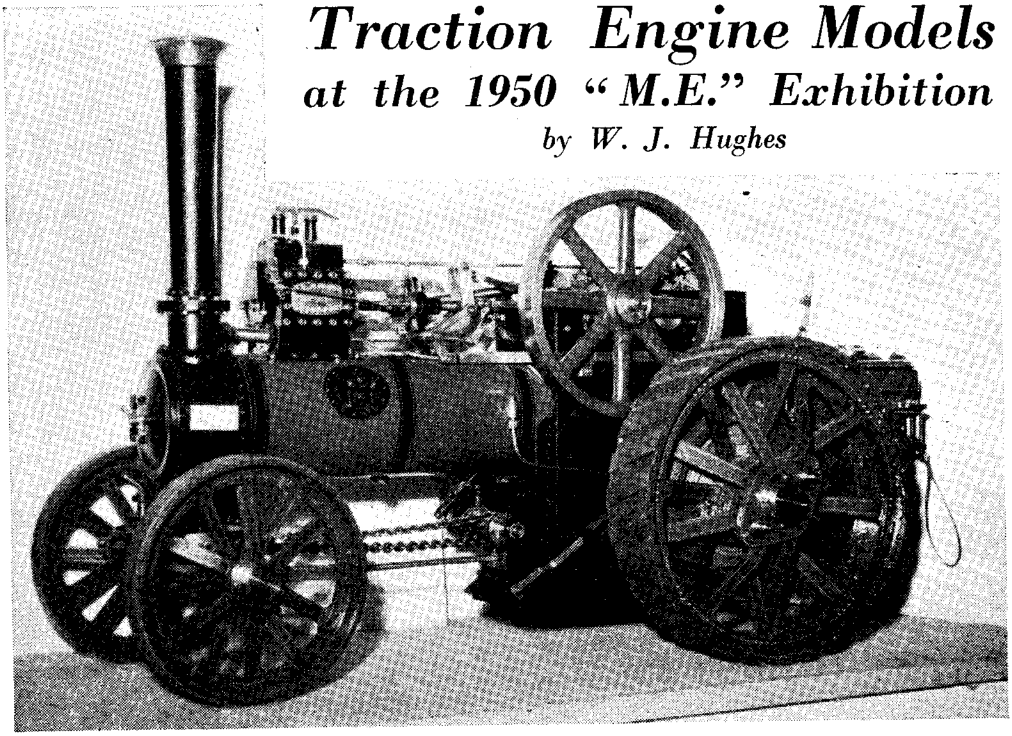


Photo 1. An imposing exhibit—the 2 in. scale traction engine by A. Jenkins (Lapworth)

RUMINATING recently on past visits to London, it was with rather a shock that I realised that more than a quarter of a century had elapsed since my first visit, when, a schoolboy of very tender years, and with about a hundred companions in charge of four or five harassed but extremely competent masters, I spent two-and-a-half days exploring the Wembley Exhibition and half-a-day visiting, by coach, some of the sights of London.

Since then it has been my good fortune to visit the capital on numerous occasions, including several holidays in the vicinity; but it is invariably with a feeling of anticipation that I approach her again, knowing that there will always be something fresh to see and something new to do.

Something of the same feeling of expectation, I find, is attached to every visit to the "M.E." Exhibition, even on succeeding days, for the best of the models will stand a very prolonged study, and a re-examination will usually disclose some new detail not noticed before.

The "Competition" Traction Engines

This year, in the Competition Section, there were only three traction engines, all single-cylindered general purpose agricultural engines. But in the Loan Section were several examples of Mr. C. E. Shackle's beautiful historical engines, and a very fine model of an American traction engine built by Mr. J. Davies, who, by the way, is hon. secretary of the M.E. section of the Road Locomotive Society.

It will probably be more convenient to deal with the three competition entries first, and here I hope that the entrants will forgive me for any criticisms I may make, for they will be made only in a friendly and helpful spirit. After all if errors are pointed out, it may prevent similar ones in future models.

The 2-in. Scale Traction Engine

A. Jenkins, of Lapworth, had entered a 2-in. scale engine as a Fowler, but this it most certainly was not. To quote a few things that were *not* Fowler, there were the safety-valves, the chimney-cap, the spud-pan, and the drawbar. The slide-valve was driven by a knuckle-joint, and there was a stay between front axle and firebox throatplate, neither of which was Fowler practice.

In addition, there was a look of heaviness about the motion work, and the flywheel was unduly heavy too. With regard to the latter, there may be some argument about the correctness of the eight spokes, but it is a fact that some Fowler engines had eight-spoked flywheels.

The road wheels, too, were rather too heavy, and Mr. Jenkins' had made the error, which unhappily is too frequent among model traction engines, of not getting *sharp* bends in the spokes at hub and rim. This shows quite clearly in Photograph 2.

At the same time, this engines was an imposing, effective and detailed model, and indeed there could not have been much criticism of it had it been entered as a "free-lance" model instead of a "Fowler." I am sure that Mr. Jenkins obtained a great deal of pleasure out of building her, and that when he runs her he gives a lot of pleasure to others besides himself. In fact, I'd be glad to have the opportunity of trying her out myself!

The "M.E." 1-in. Scale Traction Engine

A. Warnett, of Uxbridge, had entered a 1-in. scale traction engine to the old "M.E." design of the 1930's, and had made a pretty good job of it, especially as this was his first attempt at a traction engine. Speaking from memory, it seemed to be a faithful copy of the original design, and the errors on it can mostly be attributed to that fact. But not all of them! For example, the steering-chain was a piece of "Meccano-sprocket type" chain, which passed right round the front of the spud-pan, fastened by a single screw, instead of being two separate pieces of proper link-type attached by screw-shackles to brackets riveted to the spud-pan at each front side. The steering wheel itself should be larger, of less clumsy section, with rim and handle polished. And, oh, that driving seat! Not the right shape at all, I'm afraid, for the originals were shapely and fitted the average posterior as accurately as tight woollen underwear!

Having now had a shot at a traction engine, I hope that Mr. Warnett will have another go, and this time bend his undoubted talents to modelling a real prototype. The results should be well worth examination.

The Other 1-in. Scale Traction Engine

The third engine was built by Mr. I. N. Woollett, of Amersham, also to 1-in. scale. It had been designed by the builder, but to follow Fowler practice. However, it was not entered as a model of a Fowler engine, though it might well have been. For it may be said at once, that in general appearance *and* in detail the model follows Fowler design very closely indeed, and Mr. Woollett is to be congratulated on the "realness" of his model. Looking at Photograph No. 4,

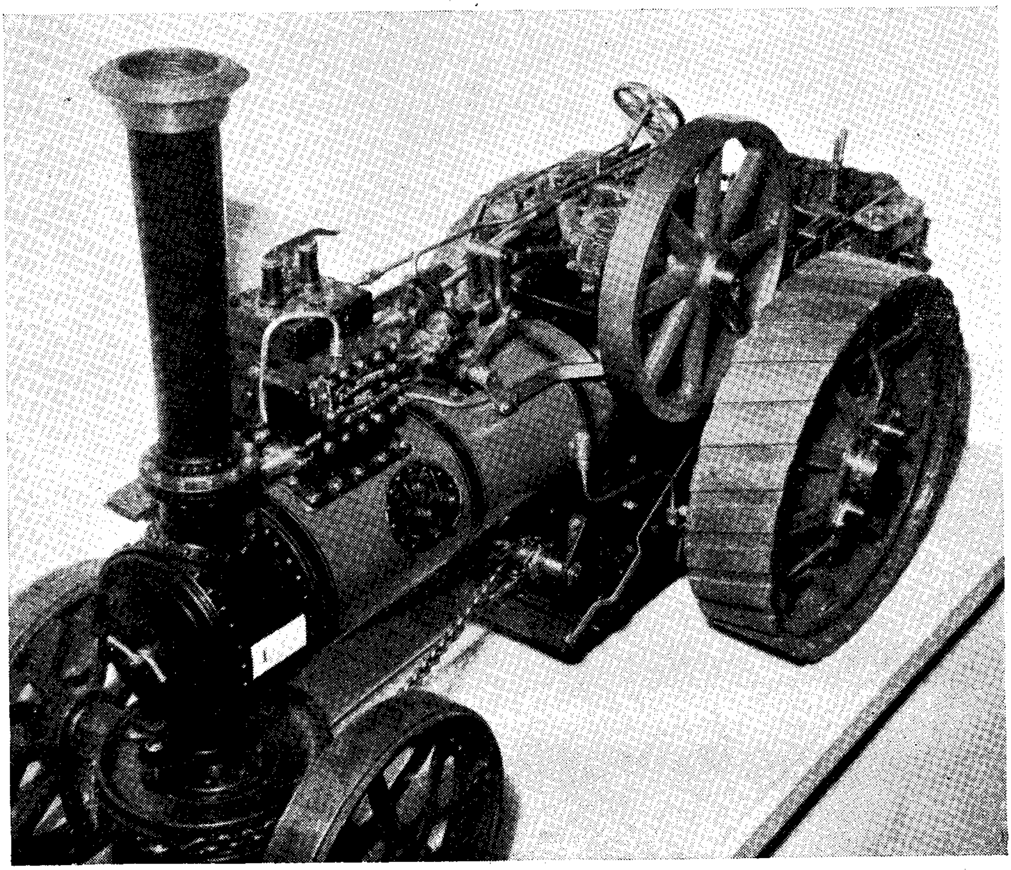


Photo 2. Another view of Mr. Jenkins' engine, to show the motion-work

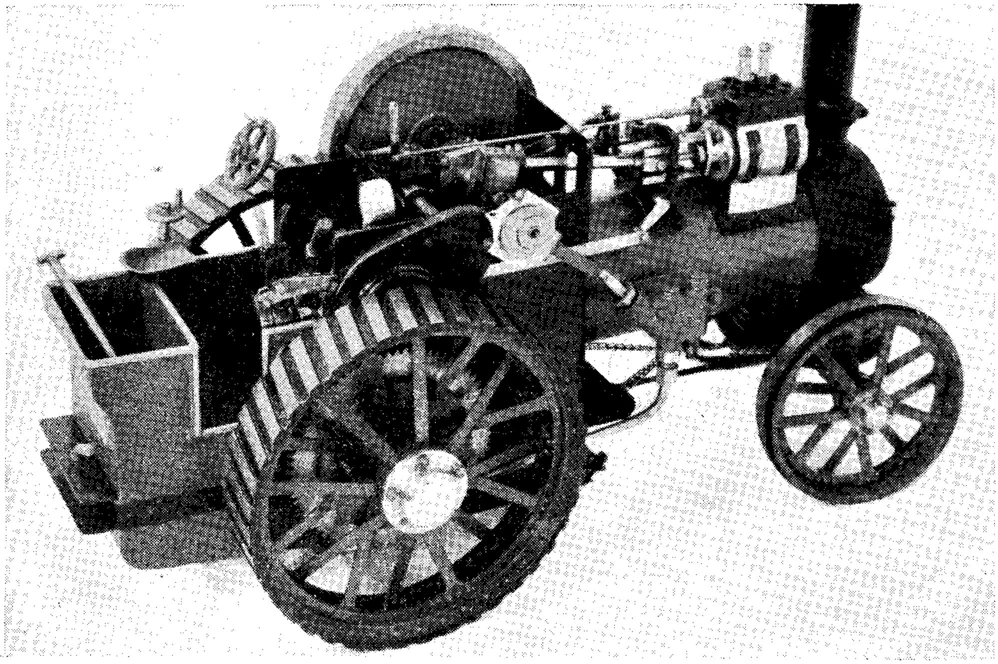
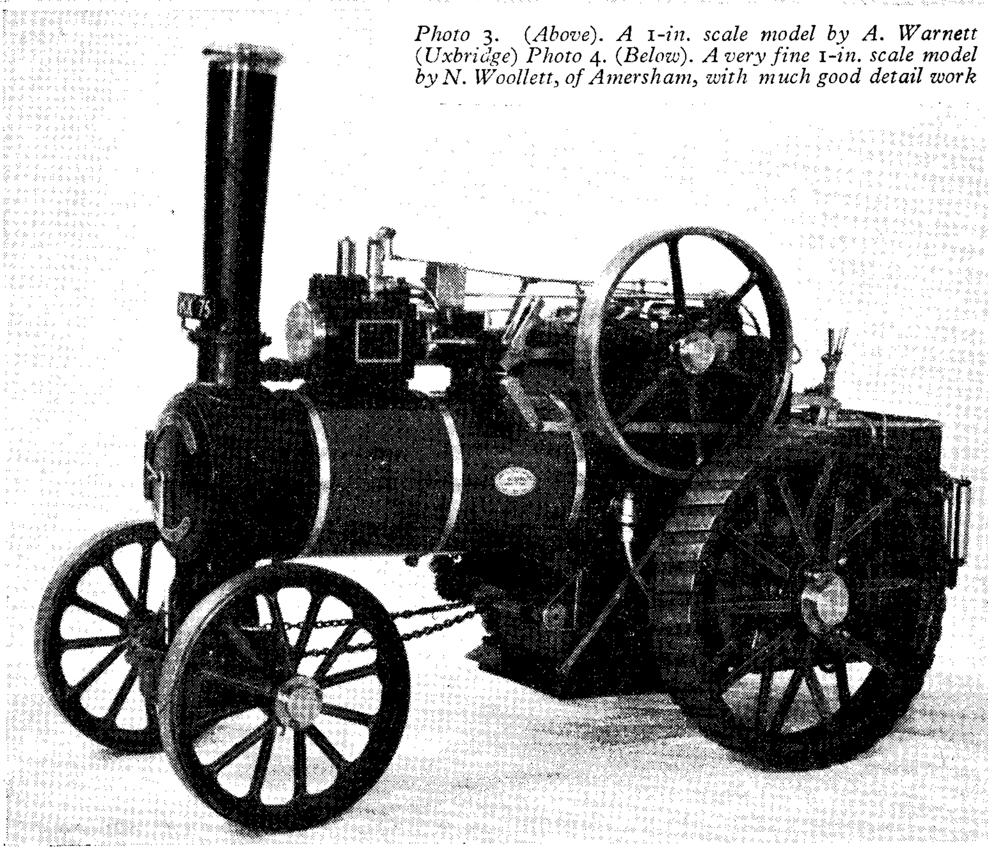


Photo 3. (Above). A 1-in. scale model by A. Warnett (Uxbridge) Photo 4. (Below). A very fine 1-in. scale model by N. Woollett, of Amersham, with much good detail work



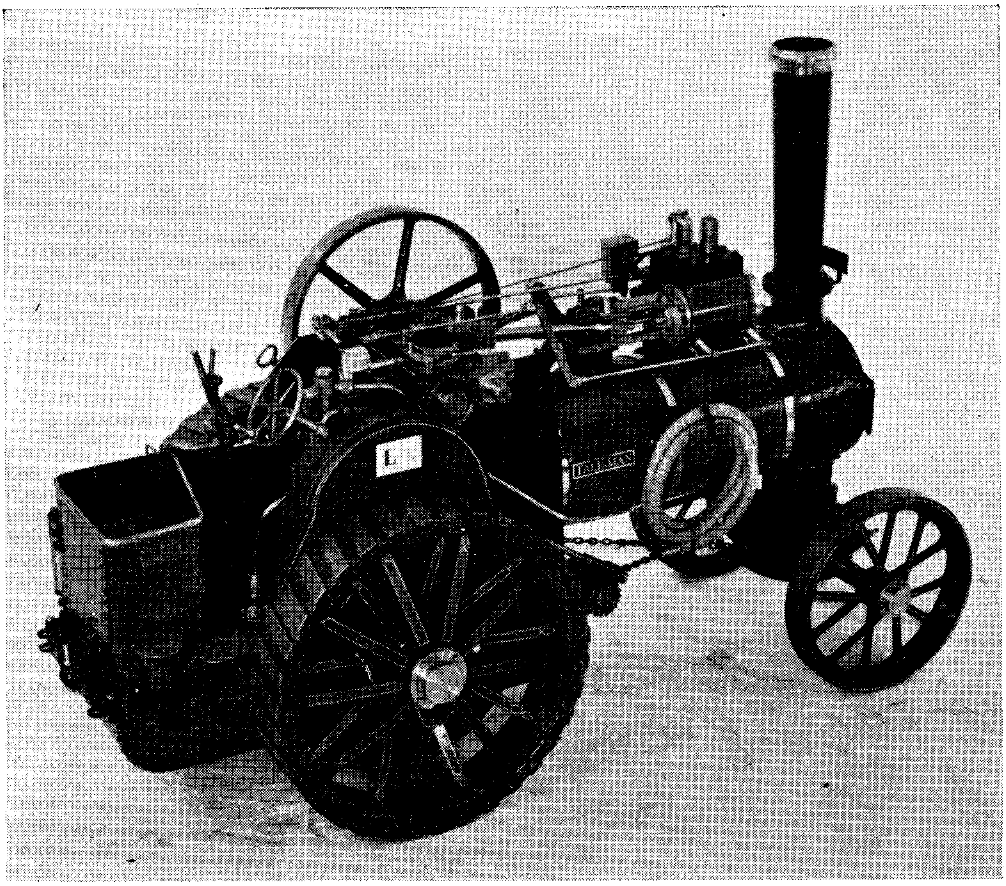


Photo 5. Another view of Mr. Woollett's engine. Compare with Photo 3 and note how much more realistic appearance due to addition of correct detail

it is extremely difficult to tell that this is not the real thing, and comparing Photographs 3 and 5, taken from the same angle, one cannot help but notice the vast difference between a reproduction of a non-prototype " design " and one on which the builder has lavished every care and attention to detail, to make it as much like a real prototype as possible.

A noteworthy feature of Mr. Woollett's engine which is much responsible for that *real* appearance, is that he has not deemed it necessary to " strengthen " working parts by enlarging the section of material. For example, his steering wheel and the various operating levers are of scale appearance, his motion-work is not clumsy-looking, and the wheel-valves are not obtrusive. In particular, the spokes and rim of the flywheel are very slim, and so are the spokes of the road wheels.

Among the detail peculiar to Fowler design, we may note on Photograph 4 the spud-pan, the chimney and especially the chimney cap, the whistle, the flywheel, the check-valve, and the fairlead with its two vertical rollers and two short horizontal ones. On Photograph 5, starting at the back, we have the drawbar, the water-filling pocket on tender side, the footsteps and manhole, the waterlifter just inside the tender opening, the gear-casing with its small extension to guard the hind wheel, gear-change bracket, operating rods for drain-cocks, slide-bars, footboard and hose, and smokebox door hinges.

The oil-boxes were beautifully made, especially those on slide-bars and big-end, which were correctly fastened on by tiny studs and nuts of at least 14-B.A. Incidentally, to avoid steel rubbing on steel, the crosshead was fitted with tiny brasses on its sliding surfaces.

Normal Fowler safety-valves are not of the column type, but set flat in the cylinder head or dome, and held down by a single central spring in a brass casing. In the model this was counterfeited by mounting a single valve in the " spring-casing," but a dummy lever might have been fitted too, to add to the reality.

It will be noticed that there are plenty of small rivets in the correct places, on smokebox, horn-plates, and header. (Mr. Jenkins had *bolted* his 2-in. scale tender together, by the way).

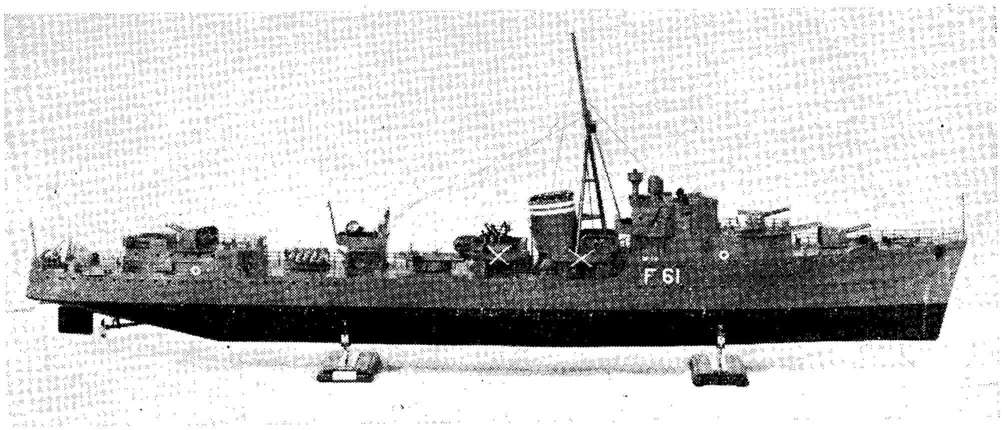
(To be continued)

Steam and Motor Vessels

at the "M.E." Exhibition

by A. D. Trollope

SPENDING my working hours correcting the shocking errors that the professional ship modeller can perpetrate, I am loth to be very critical of the errors that occur in the amateur-built model; but I feel certain that any criticism that I may make of the models at the Exhibition will be taken in the spirit in which it is made, with the idea of helping and guiding the keen model maker, who so often spoils hours of painstaking labour by some detail that he does not realise is wrong.



A "Javelin" type destroyer, scale 1/50th, by G. W. Miller, exhibit No. 8

The general standard of workmanship at this year's Exhibition was certainly as good as in previous years and in the case of hulls, was very definitely better. There were, however, many instances of excellent vessels being spoilt by small incorrect detail work.

An Outstanding Model

The outstanding exhibit in my opinion was No. 8, an electrically-driven model of H.M.S. *Javelin.* Whether an electric motor is sufficient to drive a model of this size at an appropriate speed is a matter of doubt, but the choice of power plant was no doubt affected by the desire to incorporate as much scale detail as possible. It was built to plans published in the "M.E." during the war when authentic details were difficult to obtain and it was not until the model was nearly completed that the builder had access to reliable information as to details of the vessel. Details that faulted the model were errors that arose through faulty information and not through bad workmanship. Had the model been completed correct in all detail with a similar standard of workmanship, it would undoubtedly have been in the championship class.

No. 11 was another very fine job, a standard Vosper design *Viking* built by Mr. Ablett, of Ruislip. The model is a very clean and attractive piece of work, the decking in particular being very well carried out. Apart from one or two minor errors the only fault appeared to be the rather odd appearance of the various deck fittings, which were polished brass. They would have looked better plated or painted, particularly the winch, which was definitely out of character. The hull of this model was an excellent job and appeared to have been built from the prototype drawings.

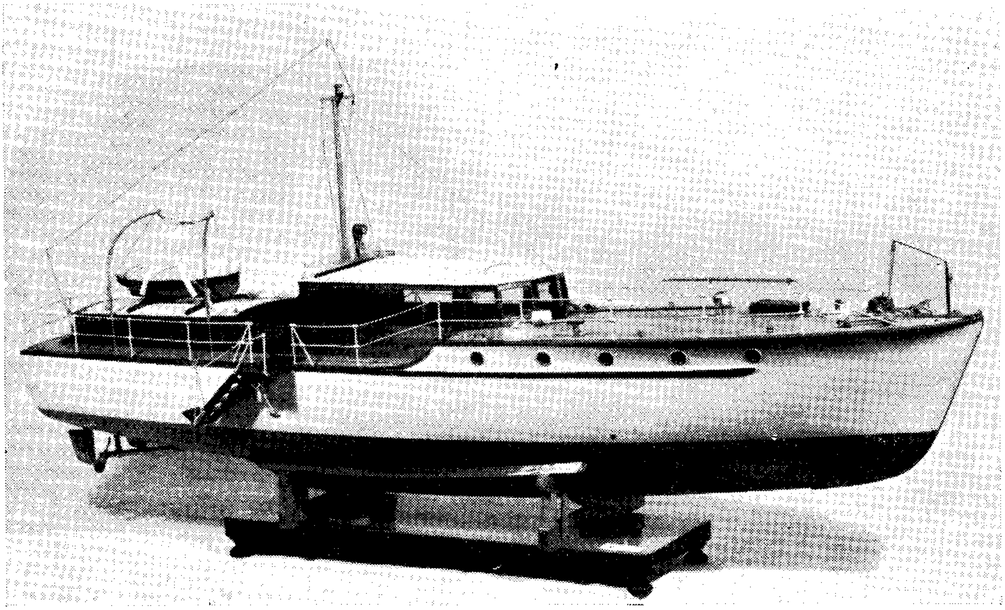
Exhibit No. 7, by Mr. Anderson, of Willington-on-Tyne, is a reproduction of the Portuguese motor vessel *Angola* to $\frac{1}{8}$th scale. Mr. Anderson is, I understand, a shipwright by profession and he has certainly made a fine job of the plated hull of the model, the plating is exceedingly neat and accurate, particularly round the difficult curve of the counter. Unfortunately, the rest of the model does not match up to the standard set by the hull and there are several deck and rigging details that are open to criticism. The finish of the decks appeared to be rather unorthodox and very impracticable in a model of the prototype.

Fishing Vessel Models

There were two fishing vessels exhibited, one of which, for some reason, bore no fishing number. No. 2 was a trawler by Mr. Gardner, of Teddington, and No. 5 a drifter by Mr. Ross, of Wallington. Both of them managed to catch the characteristics of the prototypes very well and both models were of a high standard though I thought Mr. Gardner's model was spoilt by

several little errors and omissions. The anchors were of the wrong type and the anchor chains were led straight off the winch on to the deck instead of being properly led to chain lockers. The bridge would have been a lot more comfortable if it had been covered in and I think the trawl winch was badly out of proportion. However, the model presented generally an attractive appearance and was very well carried out.

The drifter, by Mr. Ross, also suffered from some minor faults, though the general appearance was excellent. Some of the rigging detail was questionable but the deck gear was excellently done and the fish baskets made of coiled twine was a little detail that I have not seen before and quite a brainwave.



A model Vosper " Viking," scale 2/3 in to 1 ft., by A. S. Ablett, exhibit No. 11

An Unusual Prototype

A rather unusual prototype was adopted by Mr. Bays, of Sheffield, for his two exhibits, Nos. 12 and 13. No. 12 was a " Liverpool " class R.N.L.I. boat, apparently electrically driven and with a very realistic appearance. I preferred it to the other exhibit, No. 13, which was a radio-controlled cabin-type lifeboat. This model had a very real appearance also, though some of the detail work was a trifle coarse, especially the stanchions, but both jobs were very creditable, despite the minor faults.

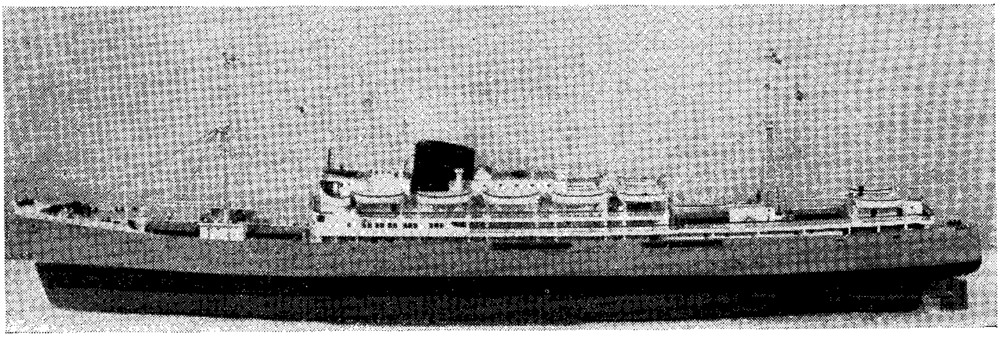
Tug models were in the minority this year, the only working example being No. 19 by Dr. Machanik, of Liverpool. This had a fine hull, excellently shaped and built and of realistic appearance, but like many others was spoilt by little errors in detail. The navigation lights were, to be frankly honest, horrible, and the flanges of the scuttles were far too wide. It is a peculiar thing that, year in and year out, the same faults appear in ship models and the most persistent of these is wide flanges on scuttles. A scuttle flange, to any scale normally used for models would only appear as a narrow band barely $\frac{1}{16}$ in. wide.

A Graceful Ship Model

There are few more graceful ships than a steam yacht of the old type and an excellent example was exhibited by Mr. Fletcher, of Colne, as exhibit No. 4. The hull was a very nice job and succeeded in fully expressing the graceful sweeping lines of the type, but some of the deck details appeared to be rather out of scale and the anchor chain was far too light for such a vessel. Some of the rigging detail was open to question, the after mast having no adequate staying aft of the shrouds. The White Ensign was in keeping with the general appearance of the yacht, as a vessel of this size would probably be owned by someone entitled to fly this flag. It is a pity that more models are not shown with appropriate flags as they go a long way to build up the appearance of a model, so long as they are the right ones.

No. 16 was, I think the only exhibit built to recent " M.E." designs and was a model of the m.v. *Penang* by Mr. Davey, of Feltham. Here again an excellent hull was rather spoilt by quite minor detail errors, scuttles and rigging again being the chief offenders. The masts also appeared to be too short for the vessel and gave it a rather stumpy appearance.

A very attractive and well planned cabin



Model of M.S. "Angola," scale ⅛-in. to 1-ft., by A. S. Anderson, exhibit No. 7

cruiser was shown by Mr. Wrench, of Weybridge, and the detail work, though rather heavy, had been well thought out and executed. I did not like the appearance of the thick perspex windows, which was rather clumsy, but the detail work in them was very good. The model appeared to be fitted with two independent steam engines, a rather peculiar arrangement which must have caused a lot of trouble to ensure them both running at the same revolutions. I could not see far along the shafts, which may have been interconnected further aft.

An Attractive Prototype

No. 18 was a smallish model of that very attractive prototype, the naval picket-boat, and was built by Mr. Woodruff, of Dunstable. There were such a variety of types of these boats and, as they are now obsolete it is difficult to check details. Checked against an official model of one of these craft which I have, the cabin of this exhibit appeared to be too short and the steering wheel was definitely oversize, but in other respects the model was a very nice job. I have for a long time been trying to get official drawings of one of these boats, as they are such delightful little ships ; up to the present, however, all my efforts have been fruitless.

Mr. Snooks, of Wembley, had bravely decided on the *Queen Mary* as a prototype, but unfor-

A model North Sea drifter, scale ⅜-in. to 1-ft., by H. G. Ross, exhibit No. 5. Note fish basket slung on forestay

tunately no model of a convenient size can ever hope to give a realistic impression of the vast size and dignity of this ship. However, Mr. Snooks had made a very good job of a difficult task, but with the dice heavily loaded against him from the start.

The once-popular A.S.R. launch was not so well represented this year, though Mr Weeks, of Cowes, with exhibit No. 14 has made a good job of his model. He has, no doubt, had ample opportunities of seeing these vessels and has used such facilities to very good purpose in making his model so attractive and realistic.

In Section H, Mr. Chapman, of Mitcham, exhibited another example of an A.S.R. launch, and he also has succeeded in catching the general appearance and character of these striking little ships very well indeed. The angle of the propeller shaft appeared to be a trifle too steep and the yellow paint on the gun turrets made the model look rather garish; otherwise, there was little to criticise.

More to Come

The radio-controlled model, which I suspect we are going to see in ever increasing numbers in the future, was efficiently represented by No. 6, a fast cabin cruiser by Mr. Lovett, of Morden. The general appearance of this model is excellent and the work well carried out, though it would appear that the vessel has been built more to exploit the radio-control gear than to be a super-detailed launch. Nevertheless, the finished job is a nice clean piece of work.

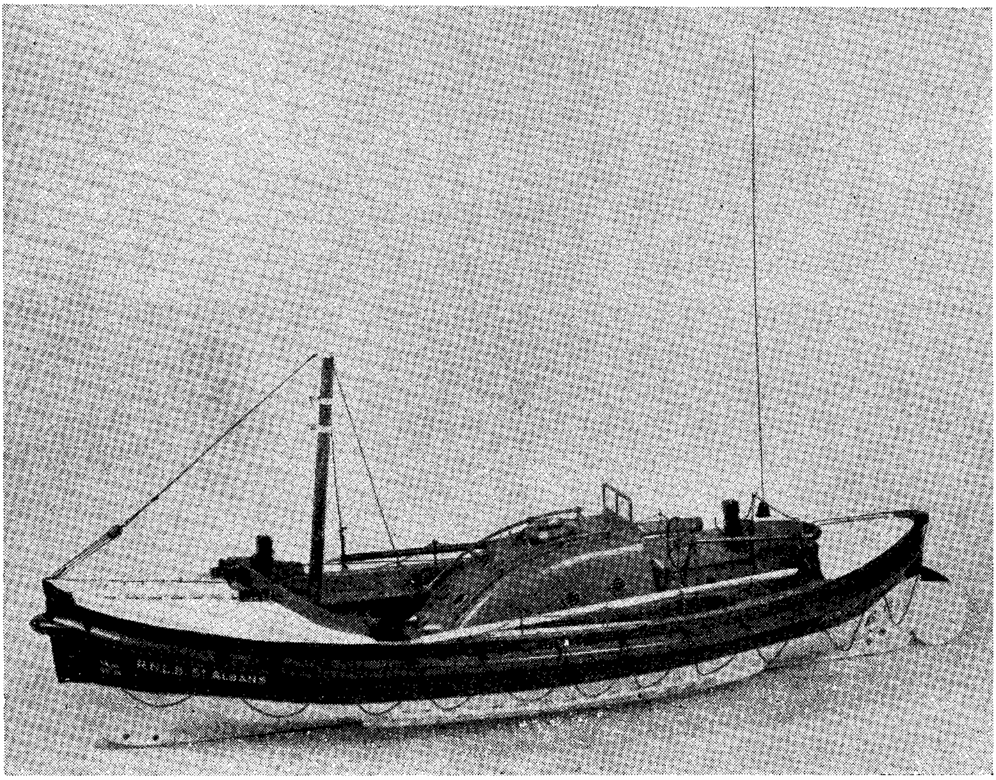
No. 9 is of considerable interest, as it is powered with an experimental steam turbine and built by Mr. Jane, of Acton. I was not able to see the power plant but the vessel itself is exceedingly well built and of clean and good workmanship. There is a lot of scope for experiments with steam turbines, so let us hope that this trim little craft will set a lead for others to follow.

A fine example of a modern cargo liner was exhibited by Mr. Knapp, of Leigh-on-Sea. No doubt Mr. Knapp has been inspired by seeing many similar " big sisters " pass his home and has certainly succeeded in catching the essential " line " of these vessels in his model. A nice design very well carried out.

Working Models

Small working models are never very satisfactory in operation, but Mr. Miskin, of Charlton, has made an excellent little job of his model of the Norwegian coaster *Heroya*. A rather unfamiliar prototype, but it has made a very attractive little model with the work in it well carried out.

No. 17, by Mr. Potten, of Twickenham, was a



A model Liverpool class R.N.L.I. lifeboat, scale ½-in. to 1-ft., by E. N. Bays, exhibit No. 12

small model of a small ship, a hard-chine motor cruiser of the type that is a familiar sight in all the coastal harbours. A very nice looking little job, well carried out, that succeeds in looking like a real ship.

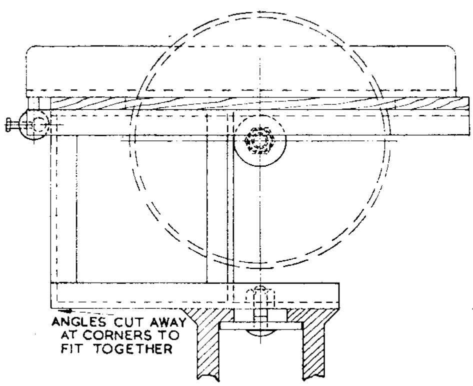
Hydroplanes and speedboats in Class "H" only succeeded in attracting three examples, one of which, the A.S.R. launch by Mr. Chapman has already been commented on under Section E. Mr. Reynolds, of Farnborough, exhibited a twin-sponson type hydroplane in this section of very neat design and construction. There does not appear to be any outstanding design features in the hull, except for the incorporation of adjustable flaps on the rear edges of the sponsons. The construction has been very well carried out and a very speedy-looking design produced.

The much-debated and debatable Hook "Hydrofin" was represented by a well-made example exhibited by Mr. Wallace, of East Ham. As to its capabilities on the water, I cannot speak ; but it appears to follow accurately the general design of the "Hydrofin" hull. It is powered with an i.c. engine driving an aerial propeller in the normal "Hydrofin" manner.

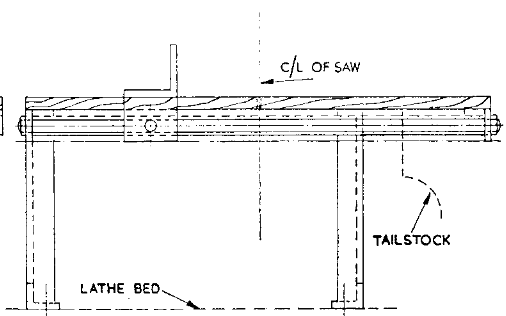
A Circular Saw Attachment

by F. T. Leightwood

AS I was rather fortunate in being offered a considerable amount of beech, oak and elm offcuts I started planning all manner of things to do with it. Unfortunately, it is one thing to draw a circle on a drawing board to represent a disc of, say, beech, 10 in. diameter × $1\frac{1}{4}$ in. thick or a length, say, 3 ft. × 3 in. ; but when it comes to sawing such pieces out of the irregular chunks of wood I have, it takes an awful lot of energy and in the latter case more skill than I possess ; that is, without a lot of planing afterwards. This being so, I took out my drawing board and drew a circle 10 in. diameter, but this time it had *teeth* in it and I proceeded to draw a mandrel, and the lathe about it.



View from tailstock end of bed



Arrangement of saw-table

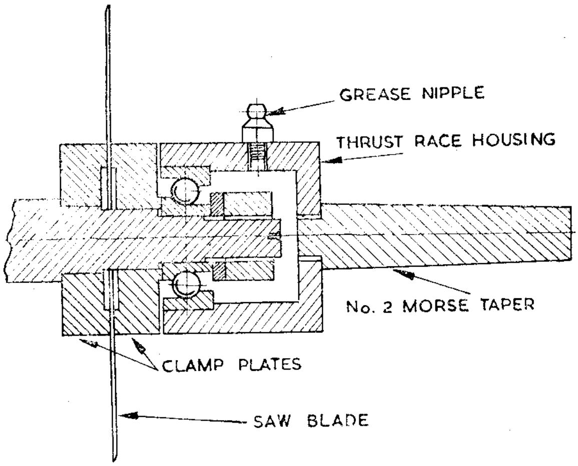
At first, I simply mounted the saw on a mandrel, one clamping plate being a very tight fit and the other being clamped up with a nut, the whole thing simply running between centres. This proved that the saw was a success, the amount of energy required being reduced (much to my delight), but checking proved that the high speed was not very kind to the back-centre and so I decided that the attachment would be well worth a little more time being spent on it.

The bearing housing was the first part made. I had a No. 2 Morse taper shank from a broken drill which was soft, so I turned the part projecting from the lathe mandrel nose to $\frac{1}{2}$ in. diameter, and screwed it $\frac{1}{2}$-in. B.S.F. On this I screwed the other half of the housing, which I had drilled and tapped to suit, and faced off the rear face. The outer rim of this part was turned to 2 in. diameter and the face cleaned up, followed by the boring operations, a shoulder being left for the ball-race to fit up to. This, by the way, is one of those designed to take axial as well as radial loads and therefore is ideal for the job.

The mandrel itself is turned to $\frac{11}{16}$ in. diameter to suit the "fixed" clamp-plate, it being easier, of course, to turn the mandrel to suit the bore than vice-versa, and when this plate was ready to fit, I forced it on, standing the mandrel on a block of wood and using a piece of tube to get an even smack with the hammer. When it was right up to the shoulder I put the mandrel back in the lathe and turned the disc all over, not forgetting the recess. This latter is important as it is essential that the saw be clamped by the outer edge of the plates if they are to give the full support and

drive to the saw. This applies to grinders too, although the soft paper glued to the stones helps when the machine has not been made in this way.

The mandrel is next turned to $\frac{5}{8}$ in. diameter to suit the saw, the "loose" clamp-plate being bored the same (and also recessed), and then to $\frac{1}{2}$ in. for the ball-race and the end screwed $\frac{1}{2}$ in. B.S.F.



Arrangement of saw-blade and ball-bearing

The saw bench consists of a simple frame of 1 in. × 1 in. angle iron welded in a square, supported from the lathe bed by short lengths of angle welded to two cross members, bolted to the lathe bed. The top of the saw bench is two pieces of $\frac{1}{2}$ in. thick plywood spaced apart to clear the saw and attached to the frame by $\frac{1}{4}$ in. countersunk screws.

The adjustable fence slides along the $\frac{1}{2}$-in. rod which is fitted to the projecting ends of the side members of the frame, and consists of a length of $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $\frac{3}{16}$ in. angle attached to a short length of round bar (drilled off centre and fitted with a clamp screw) by a piece of $\frac{1}{2}$ in. square steel, these also being welded together.

A guard of 16-s.w.g. steel is fitted by an arm bent from $\frac{1}{4}$-in. bar, a lug attached to the side of the frame being provided to carry it, the guard being locked in position by a set-screw.

In operation, the saw cuts very easily and cleanly, requiring little energy, although the actual cutting speed is rather lower than that which the saw is designed for. By keeping the mandrel as long as possible I can cut wood 6 ft. long in half and when using the fence I can cut almost any length, straight and parallel, requiring just a small amount of planing.

For the Bookshelf

Traction Engines Worth Modelling, by W. J. Hughes. (London : Percival Marshall & Co. Ltd.). 160 pages, size 6 in. by 9 in. Profusely illustrated in line and halftone. Price 12s. 6d. net.

This is probably the first book, in any language, to deal exclusively with the general constructional features of that one-time numerous and essentially useful machine commonly known as a Traction Engine. In ordinary parlance, the term "traction engine" was applied to any steam-driven, four-wheeled prime mover constructed for use on the public highway ; to the initiated, however, there were three main categories of these machines, and Mr. Hughes is careful, at the outset, to explain the differences.

But, no matter whether it was a "tractor," "traction engine" or "road locomotive," the machine possessed a fascination all its own, which affected large numbers of the public in some manner that defies explanation and persists, in spite of the fact that these machines are now almost extinct.

To anyone who has fallen a prey to that fascination, this book will be a joy ; the illustrations alone ensure that. The first eleven chapters are devoted to describing and illustrating all the fundamental details of construction, while chapters 12 to 17 describe, severally, six well-known makes of road engines, including the Aveling & Porter steam road-roller. Chapter 18 is a general rounding-off of the subject and includes a bibliography of books and periodicals from which information on road locomotives can be obtained.

Written in a light and attractive style, the text is never dull ; but it is practical, descriptive and anecdotal in turn, with a great deal of advice to people who wish to reproduce in miniature some favourite make of road locomotive. The author is himself a model engineer, and he knows exactly the kind of information required, born of his own experience in building a $1\frac{1}{2}$-in. scale Allchin general-purpose traction engine.

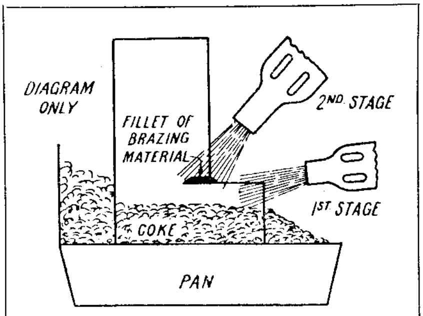
However, it is not only to the model engineer that this book will appeal ; anyone who is interested in the design and construction of road locomotives will wish to possess it, since it is the sort of book an enthusiast can pick up and enjoy at any time. The dust-jacket, reproduced from a water-colour painting by Mr. Hughes, is the most appropriate that could have been made for such a book.

"L.B.S.C.'s" Beginners' Corner

How to Braze the "Tich" Boiler Shell

THE weather being a little cooler at time of writing, we will now tackle the first brazing job, and beginnners will find that it really *is* easy—like everything else, just a case of knowing how. Young Curly and his boy friend found that out when they brazed up the broken mailcart axle. A minor but important point, is first to make sure there is plenty of oil in the blowlamp; or if you are using an air-gas blowpipe working through a slot meter, see that there is no likelihood of the supply failing in the middle of the job. If the source of heat dies out on you, the result is likely to be disappointing, to say the least of it. Also, have everything you need (see my list in the previous dissertation) ready to hand, for the job must be absolutely non-stop; and have the pickle bath handy.

First, mix up some of the flux—Boron compo or whatever else you are using—to a creamy paste with water, and lay a fillet of the paste all along the joints, at each side of the throatplate, around under the barrel, and along the barrel seam. Cover all the rivet heads. Then put a layer of coke or breeze in the brazing pan, and stand the boiler shell on end in it, with the barrel pointing skywards. Pile the coke or breeze all around the outside, to within ½ in. of the throatplate; also put some inside, to the same height. Now get the blowlamp or blowpipe going good and strong, and start playing the flame on the coke close to the boiler shell. Get it glowing dull red as far around the job as you can. The wet flux will start to bubble, dry out, and presently begin to fuse, and form a glaze over the joint. Now concentrate the flame on one bottom corner of the throatplate; and as soon as this part becomes bright red, dip your stick of easy-running brazing strip in some dry flux—if you hold it in the lamp flame for a few seconds before dipping, a coating of flux will stick to it—and apply it to the hot spot. You will be pleased to see that it immediately melts at the tip, the molten metal running into the joint just like ordinary soft solder. If it *doesn't* melt and run, the job isn't hot enough, and more "therms" are called for. Incidentally, those good folk who are not used to a blowlamp, invariably try to operate it at too low a pressure. There should be no trace of white in the flame, and it should roar away like nobody's business, the flame being blue nearest the nozzle, and slightly orange-violet at the tip. Whilst over in the U.S.A. I had the use of Calvert Holt's workshop, which had a sort of annexe where we did all the soldering and brazing. In addition to air-acetylene equipment, Holt had a huge blowlamp, with a tank about the size of a five-gallon oil drum, and a burner about double the size of the average five-pint lamp, which was connected to the oil tank by a flexible metal tube. The row this fearsome bit of apparatus kicked up when going all out, is easier imagined than described; and the flame, over 2. ft. long was — well, reminiscent of the nether regions. It practically enveloped most jobs, and very little coke packing was needed, even for a 3½-in. gauge boiler.



How to braze the boiler shell

Scared Stiff!

One day I had this implement of Hades going on a big boiler shell, and was just doing the last bit, when suddenly there was a succession of terrible piercing screams, louder even than the roar of the burner. I shut down mighty quick, thinking that maybe a couple of gangsters had got in and were trying to murder Mrs. Holt before ransacking the place. The screams continued, and then something collided with me and nearly knocked me into the brazing forge. It was Holt's little boy, running around with his eyes shut, and yelling blue murder! I picked him up and took him to his mama. It transpired that he had heard the noise of the blowlamp in the house, and had come to investigate; but the sight of the huge flame, the glowing coke, red-hot boiler shell, and behind the lot, your humble servant's face with two green eyes shining out of it (they used to reflect just like an animal's eyes, a phenomenon which persisted up to middle age) and the awful roar on top of it all, sent the poor kid into complete panic. It was weeks before he ventured into the workshop again!

Non-stop Run

As soon as the brazing strip melts, and runs into the end of the joint, move the blowlamp flame along a weeny bit; then directly that place becomes bright red, give it another dose, continuing the same way, until you have filled the full length of the joint with the melted "spelter" (the coppersmiths' term for the brazing material) and reached the underside of the barrel. Now note: describing the operation thus, for the sake of making it plain and clear enough for the veriest Billy Muggins to understand, it would appear that the operation is done in jerks, in a manner of speaking. Actually, it isn't, the action being

practically continuous, as you'll find out when you come to do it. The heat conductivity of copper is very high, so that the metal close to the lamp flame is very nearly as hot as that actually in the flame ; and it needs only a matter of seconds, after you shift the flame, for the fresh section to become hot enough to melt the brazing material. At the same time, the molten metal in the joint just behind the lamp flame, after it is moved, doesn't get time to cool sufficiently to " set," before the next lot comes in and joins it ; so that by moving the lamp flame at very slow speed, using care and discretion, you get what is known as a continuous run of metal, unbroken for the full length of the joint. This ensures great strength, and complete freedom from leakage. A very small amount of practice will enable anybody with the average amount of " gumption," to get the brazing material to penetrate the full depth of the flange, and fill up the crack between the edge of the throatplate and wrapper, neat enough to eliminate any need for filing smooth. The condition known as " almond rock " is invariably caused by lack of heat, so that blobs of unmelted spelter cling to the surfaces of the copper, looking just like almonds sticking out of the top of the delectable delicacy just mentioned.

Repeat operations on the other side of the throatplate, starting from the bottom corner and working up to the barrel. This time, when arriving at the barrel, keep the flame on the end of the joint for a few seconds more, and give it a little extra brazing material, so as to ensure a sound joint at the point where barrel and wrapper join. Then work your way around the curved joint between barrel and throatplate, moving the blowlamp flame very slowly, and letting a good fillet of the melted spelter run into the joint. When you arrive at the other end, give that an extra dose, same as at the starting end, and see that the metal thoroughly amalgamates.

If there is any sign of bubbling in the melted metal, at any part of any of the joints, apply the pointed end of the scratching wire in the flame of the lamp. This will break up any borax bubbles caused by moisture in the flux, and there won't be any irritating " pinholes " to plug up in the finished job.

By aid of the big tongs, lift the boiler shell clear of the coke, and lay it down again on its back, with the longitudinal seam under the barrel uppermost. Pile some coke around each side of the barrel, and put some inside as well, about halfway up the diameter ; then play the blowlamp flame partly inside and partly outside, so as to get the coke well heated up. Then concentrate on the joint at the end of the barrel ; get that well red, apply your strip of brazing material, not forgetting to keep dipping it in the dry flux, and as soon as it starts to melt and run into the seam, work your way very slowly along the full length of the seam, in exactly the same way as you did on the other joints. As the heads of the rivets come within the flame, give each of them a spot of brazing material ; don't forget to use the scratching wire as soon as any bubbling takes place. Sometimes you get a job which doesn't show a bubble from start to finish ; at other times there are plenty, and it is nothing but scratch and scratch, all along the joints to get rid of them. When the end of the seam is reached, at the throatplate, have a special blow, to melt the brazing material on the throatplate joint at this point, in order that the metal in the seam may properly amalgamate with it, and ensure that there is no leakage ; very important, that !

Make absolutely certain that no places have been missed ; then let the shell cool to black, pick it up with the big tongs, and carefully put it in the pickle bath. Mind the splashes ! A big sheet of brown paper held between the operator and the pickle bath is a fine interceptor, and may save the cost of a new overall, or even new clothes. Acid splashes are very insidious ; they don't show any damage at the time, but ere many days are past, a " moth hole " appears at every place where a splash has landed and dried. Liquid ammonia, as used for domestic washing, is a good antidote for splashes. If you get any on your skin, wash it off at once, and no harm will come of it ; if allowed to dry, you will have a red itchy patch, or maybe a raw place which will take a long time to heal. Vaseline, boric acid ointment, or any protective agent such as " Rozalex," rubbed into the skin before operating, is good insurance against acid splashes on your skin.

Leave the shell in the pickle bath for about 15 to 20 minutes, then fish it out with the tongs, and wash it well in running water. If the acid pickle hasn't dissolved all traces of burnt flux, and glazed patches are still showing around the joints, a file which has seen its best days will remove them. If using it in the ordinary way doesn't shift the bits of glazed flux, break off the tip of the file, so as to leave sharp edges, and tap the glaze with it. This will split it up, and cause it to flake off. Finally, give the shell a clean-up with a handful of steel wool ; or if that isn't available, scour it with some of the powder used for cleaning baths, sinks, and the like. Clean copper is much nicer to handle, as I've often remarked ; and dirty copper may infect any small cuts or scratches which you may have on your hands. I've usually got a few, though I'm blessed if I know how or when they come !

If our beginner friends manage the job above, fully detailed out for their especial benefit, and get nice clean even joints, with the brazing material showing at the inner edges of the throatplate flanges, and the inner edge of the barrel seam, they need have no fear of not making a successful job of the whole boiler, or in fact any boiler they may tackle at a future date. Larger boilers such as those on *Doris*, *Pamela*, *Hielan' Lassie* and so on, are operated on in precisely the same way, the only difference being that more heat is needed to heat up the larger bulk of the metal. It isn't worth while detailing out the oxy-acetylene process in connection with this boiler, because the odds are a million dollars to a pinch of snuff that raw recruits won't possess the necessary outfit. From some of the letters I receive, it appears that equipment is often severely limited, hence my desire to keep the jobs as inexpensive as possible. Only this week, a letter arrived from a Colonial reader who possesses only a few hand tools, begging me to describe in full, how to build a locomotive without using a lathe. As the majority of the components of a steam locomotive are finished

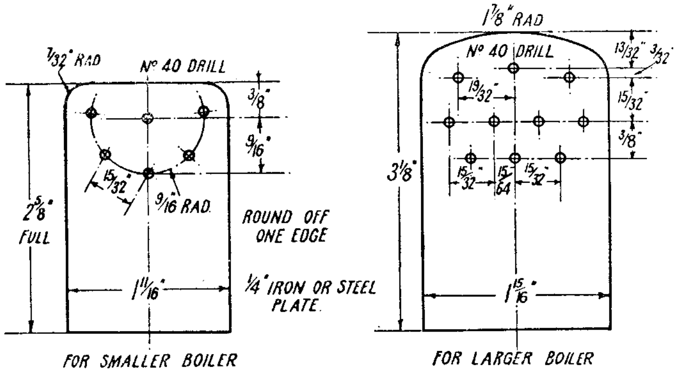
on a lathe, the cost of buying them ready-made, would go far towards purchasing a used sample of that useful machine ; maybe any other readers of this journal who are in a similar position, will take the tip.

How To Make the Firebox

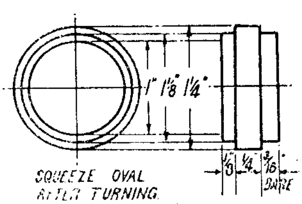
The firebox is made in three pieces ; tubeplate, doorplate, and combined sides and crown sheet. The tubeplate and doorplate are flanged up over a forming plate, preferably of iron or steel, though some folk have managed with hard wood formers. It is quite possible that our approved advertisers will supply cast forming plates, or formers, as they are called for short. If not. they can easily be sawn out of ¼-in. iron or steel plate. This isn't quite as formidable as it sounds, as a good make of hacksaw blade, lubricated with the same kind of cutting oil or other compound used for turning steel, will simply walk through the plate, if a speed of about 60 strokes per minute is used, and plenty of pressure put on the saw frame as it is pushed forward—literally throw all your weight into it ! The formers for both boilers, larger and smaller, are shown in the illustrations ; mark out to the sizes given, saw close to the lines, finish with a file, and round off the sharp edges on one side of the former, so that you get a flange on the copper plate which is rounded, instead of sharp.

The former is also used as a jig for drilling the tube holes. Set out on it, the location of the tube holes as shown ; make a centre-pop exactly at each point, and drill through the plate with a No. 40 drill. Lay the former on a piece of 16-gauge soft sheet copper, and draw a line around it ¼ in. away from the edge, except at the bottom, which needs no flange. Mark out two plates thus, and cut them out. It doesn't matter about trimming with a file ; trim up after flanging. If the copper appears hard, heat it to medium red, and plunge into cold water, which will soon soften it. Put one of the copper plates in the bench vice, with the former alongside it, and beat down the projecting edge of the copper, over the edge of the former. Note, the rounded edge of the former is placed next to the copper. If the copper begins to buckle or crinkle under the beating, re-soften it immediately, as described above, otherwise it will go hard, and crack. Before removing the first copper plate from the former, put the No. 40 drill through all holes in it, and carry on right through the copper ; this will locate the tube holes. The second plate is not drilled, as a big oval hole has to be cut in it for the firehole ring. Any raggedness on the edges of the flanges, may now be filed off, and the flanges themselves cleaned up, all ready for brazing to the sides and crown sheet.

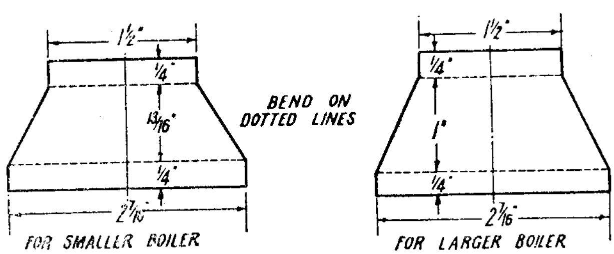
The hole for the large tube, or superheater flue (centre one of the top row) is opened out with a 39/64-in. drill, and reamed with the "lead" end of a ⅝-in. parallel reamer. If you have no



Firebox formers



Firehole ring



Crown stays before bending flanges

reamer, file it with a small half-round file, until a piece of $\frac{3}{8}$-in. copper tube will fit it tightly; and bevel it a little on the side away from the flange. The other holes are opened out with a 23/64-in. drill, and reamed or filed likewise, using a $\frac{3}{8}$-in. parallel reamer. All the tube holes should be countersunk or bevelled on the side away from the flange, to form a channel around each tube, which is filled up with silver-solder when the firebox and tubes are assembled.

lip outwards and down, into close contact with the doorplate, so that the plate is gripped tightly between the beaten-down lip and the shoulder of the ring. The same size of ring is used for both the alternative boilers.

Sides and Crownsheet

The exact length of the piece of copper needed for the sides and crownsheet of the firebox for either boiler, is obtained from the tubeplate or

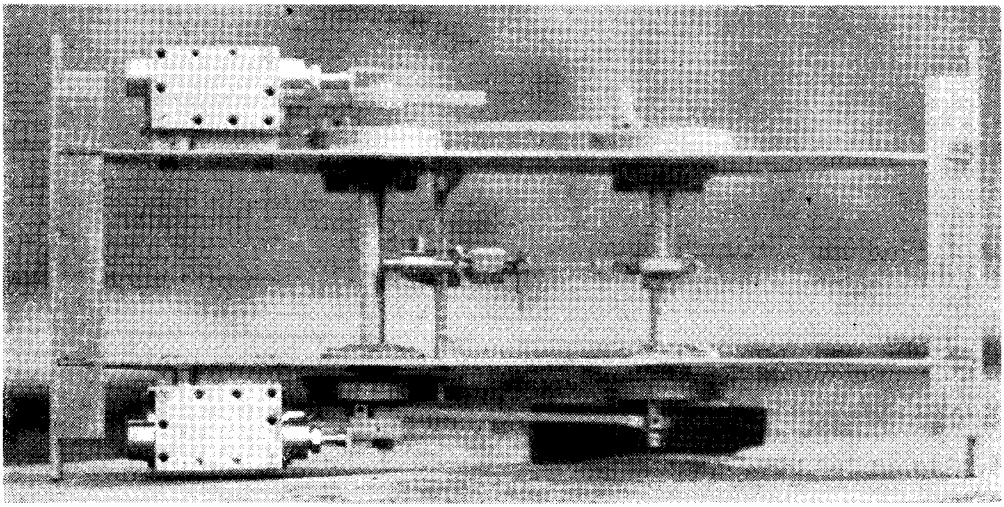


Photo by) *(L. J. Hibbert*

Overhead view of " Tich " chassis, showing pump

Firehole Ring

The firehole ring is of a special type designed by an old friend and fellow-conspirator of the L.B. & S.C. Rly. It needs no rivets, and forms a very substantial stay between the doorplate and the boiler backhead. To make it, you need a small piece of copper tube $1\frac{1}{4}$ in. outside diameter, $\frac{1}{8}$ in. thick, and about $\frac{9}{16}$ in. long. If the piece of tube is sawn, allow sufficient extra, to true up both ends in the lathe, to the given length. Chuck in three-jaw, face the end, and turn a step in it with a knife tool. The step should be $\frac{1}{16}$ in. deep, and $\frac{1}{8}$ in. long; a drop of cutting oil on the tool, will help to get a clean cut. Now reverse the ring in the chuck, and give the other end exactly the same treatment, cutting back far enough to leave the centre piece exactly $\frac{1}{4}$ in. long. Anneal or soften this by heating to red and plunging in cold water, then put it in the bench vice and squeeze it oval, so that the inside measurements will be approximately $\frac{3}{4}$ in. $\times$ $1\frac{1}{4}$ in. Lay the now oval ring on the door plate, $\frac{1}{4}$ in. from the top, and midway between the sides, and scratch a line all around it. Drill a row of 3/32-in. holes all around the inside of the line, and break out the piece; smooth the ragged edges with a half-round file, until the reduced part of the ring will just fit tightly. One flange will be slightly shorter than the other; push this one through, from the opposite side to the doorplate flange, and beat the projecting

doorplate by the simple expedient of running a piece of lead fuse wire, or ordinary soft copper wire, right around the flange of either plate, and then straightening it out. The width of the piece is 2 7/16 in. for either boiler. Cut it from 18-gauge sheet copper, and carefully bend it to the shape of the tube and doorplates; this is easily done by marking on the copper, the places where the bends come. Put a piece of round bar, say $\frac{1}{2}$ in. or $\frac{5}{8}$ in. diameter, in the bench vice, with about 3 in. of it projecting from the side of the jaws; lay the piece of copper over it with the marked place resting on the bar, and press downwards. That is all there is to it! I've done dozens of them that way, and still do, if the radius or length is beyond the capacity of my bending machine.

Fit the firebox tubeplate into one end, flange first, and secure it with a few $\frac{1}{16}$-in. round-head copper rivets at about $\frac{3}{4}$ in. centres, just sufficient to hold the parts together whilst being brazed; ditto repeato on the doorplate end. The plates should be flush each end, with the sides and crown, so as to leave a little groove, which is filled up with the brazing material, and makes the firebox as sound as though in one piece.

Crown Stays

Two simple girder-type crown stays are used. These are not only easier to make and fit, than a

(*Continued on page* 325)

Novices' Corner

Shaft Collars

COLLARS are fitted to a shaft either for the purpose of locating it or as a means of retaining a component, such as a loose pulley, in position on the shaft.

It is essential, therefore, that these collars should be a good fit and that they should be well secured.

Drilling for the taper pin, which is the securing device shown in Fig. 1B, is greatly facilitated by making the collar a firm fit on the shaft. However, it is inadvisable to rely on this alone and the collar should be held in position by means of two toolmakers' clamps or some other simple constraint. If the clamps are made to grip the shaft on either side of the collar, the latter will not be thrown out of position during the drilling process, for the collar will not then be able to move laterally and can be retained against a positioning line which has previously been scribed upon the shaft.

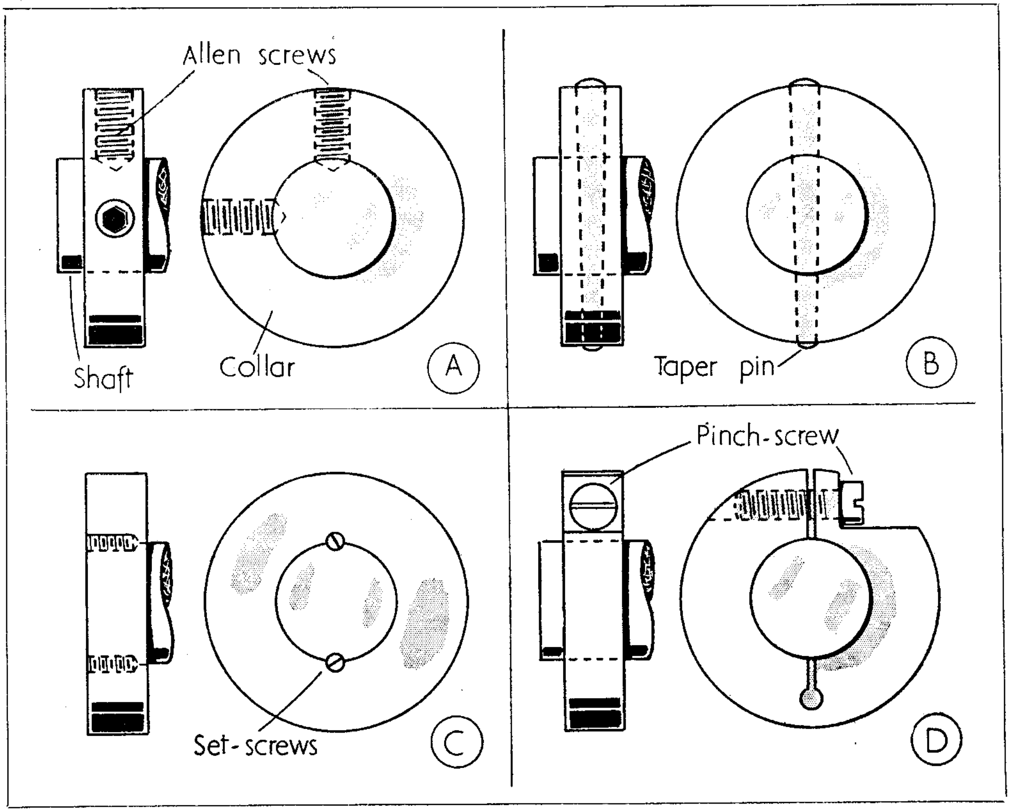


Fig. 1. *Four ways of securing shaft collars*

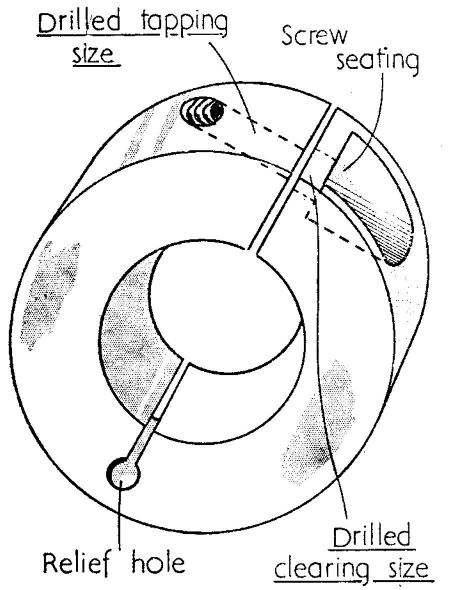
To ensure this requirement when making collars, the blanks from which they are formed must be bored to a close push fit over the shaft. Otherwise it is probable that, when finally fitted, they will be out-of-square.

Four methods of securing the collars are commonly used and these are shown in Fig. 1A-D. The fixings shown in *A* and *B* are suitable when the collar is to be fitted in a predetermined position and requires no subsequent movement for purposes of adjustment. The collar shown in Fig. 1A, can, however, be provided with lateral adjustment if two flats are filed on the shaft, but the set-screws must not then be set in dimples, or no adjustment will be possible.

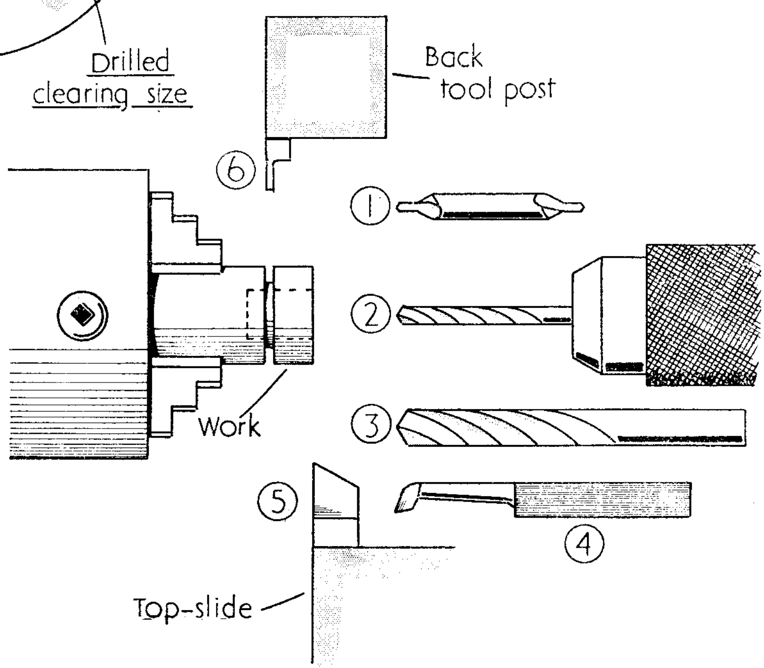
It is sometimes necessary to secure a collar so that its face is flush with the end of the shaft upon which it is mounted. Though this may be carried out by either of the two methods previously described, it is also possible to lock the collar securely by fitting two set-screws or grub-screws in the manner shown in Fig. 1C. The screws are tapped half in the shaft and half in the collar. As the latter is not subjected to any radial load,

the screws can be quite small and unobtrusive. Of course, with this method no subsequent lateral adjustment of the collar is possible.

By far the most useful method of fixing collars is that shown in Fig. 1D. Here, it will be seen, the collar is split and is provided with a pinch-screw. Lateral adjustment of this form of collar is extremely easy. At the same time the gripping power is great, thereby firmly securing the collar to the shaft. When large collars are made it is permissible to form the abutment face for the screw head by sawing away the unwanted metal, as shown in the illustration. In small collars, however, such a procedure would leave insufficient material to withstand the force of the screw, and the tongue upon which the screw seats would undoubtedly bend inwards. To avoid a failure in this respect the screw seats of small collars are formed by end-milling. This leaves a shroud at each side of the seating and so prevents its collapse. This shrouding can be seen in Fig. 2. Wherever possible, it is preferable to use Allen screws for securing shaft collars, for they can be tightened more firmly than the ordinary screw. As Allen screws are obtainable, both as grub-screws and cap-screws, as small as No. 4 B.A., they are very suitable for the applications shown in Fig. 1C and 1D where a neat appearance is essential.



Above—Fig. 2. A split collar, showing the details of the screw seating



Right—Fig. 3. Machining blanks for shaft collars

Making Shaft Collars

The initial operations in making the four types of collar shown in the illustrations are the same, and are shown in Fig. 3, where it will be seen that a piece of round material is gripped in the self-centring chuck and is then centre-drilled, operation 1, pilot drilled, operation 2, and drilled ready for boring, operation 3. The work is then bored to a close fit on the shaft, operation 4. The collar is then turned on its outside diameter to clean up the surface, operation 5, and is then parted off to length, operation 6.

Subsequent operations on the collars shown in Fig. 1A, B and C, are all simple work of a nature previously described in these notes. The collar shown in Fig. 1D requires the screw-head abutment face to be formed by sawing and sub-

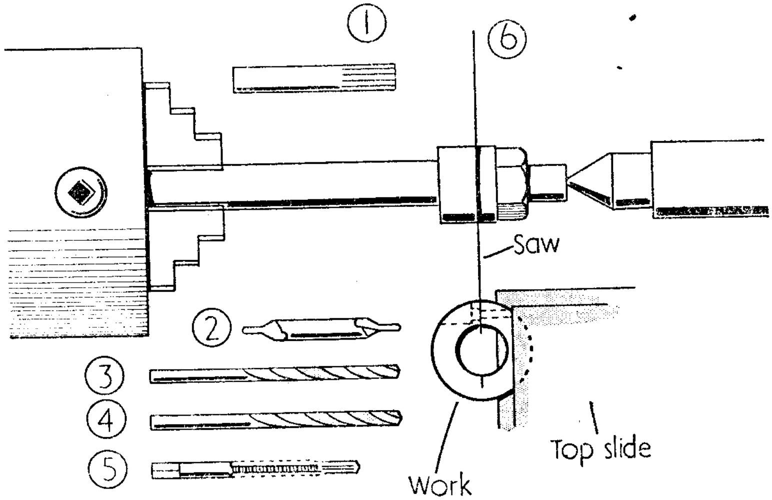


Fig. 4. Machining the screw seating in a split collar

sequently filing to a good finish, after which the centre of the abutment face may be marked off and the work set up in a machine vice so that the hole for the pinch-screw may be drilled for tapping to size. The collar is then split with a hacksaw and a relief hole, of some suitable size, is drilled at the bottom of the saw cut, as seen in the illustration. The work can then be reset in the machine vice and a clearing size drill put through the upper half of the collar from the screw abutment face to afford a clear passage for the screw.

The finishing of the collar shown in Fig. 2, is, however, somewhat more complicated ; fortunately it can all be carried out, at one setting, in the lathe. The sequence of operations is shown diagrammatically in Fig. 4.

Milling the Seating

As will be observed, the first operation is milling the seating for the clamp-screw. The work is first clamped under the top-slide tool-post and packing is interposed to ensure that the milled slot is formed centrally. In order to determine the height to which the work must be packed, the collar is first painted with marking fluid and a centre-line is then scribed, with hermaphrodite calipers, on the circumference. A scriber is then gripped in the self-centring chuck and packing is interposed between the work and the surface of the top-slide to bring the scribed line into alignment with the point of the scriber when the collar is firmly clamped.

When the work has been secured correctly, a suitable end-mill is gripped in the chuck and is fed into the work, taking light cuts, for a depth which will provide a full seating for the screw-head. At the same time, care must be taken to see that sufficient material is left between the seating and the location of the saw cut which splits the collar to ensure that there is no weakening at this point.

When the milling is completed, a note is taken of the cross-slide index reading with the cutter fed into its full depth. This is important, for the cross-slide must now be locked in this position. Should the slide be moved inadvertently, it can then be re-set to the reading taken and thus ensure that the subsequent operations are carried out in the correct position.

The milling cutter is now removed and the work is centre-drilled with a Slocombe drill held in the chuck, operation 2. The collar is then drilled tapping size, operation 3, and then clearing size, operation 4, before being tapped to receive the clamp-screw, operation 5.

For the sake of clarity, in the diagram the tapping is shown as being performed in the lathe. This procedure may be adopted with advantage where large collars are concerned, but the smaller sizes of screw used with collars of modest dimensions render machine tapping inadvisable. Small collars, must, therefore, be tapped by hand.

Saw Straight and True

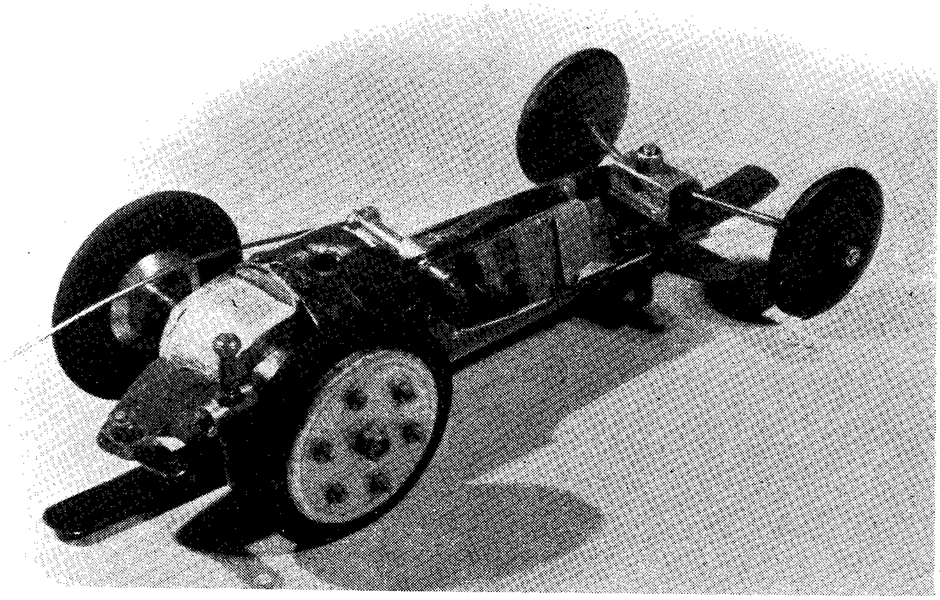
Finally, in operation 6, a cut is made along the centre-line with a circular saw, as shown in the illustration. If no saw is available, a hand hacksaw must be used, and in this case great care must be taken to saw straight and true, or the appearance of the work will be spoilt. The width of the saw cut is not material, but a narrow cut has the best appearance and should preferably not exceed 0.020 in. wide. Circular saws which will cut kerfs of this size are obtainable, but there may be some difficulty in finding a supply of hand hacksaw blades as narrow as this, though the writers of these notes were once fortunate enough to secure some blades measuring 6 in. × ¼ in. × 0.016 in. thick.

The hole at the bottom of the saw cut should not be drilled until after the cut has been made, for it is better, and simpler, to make the hole conform to the saw cut, rather than to try to saw to the centre of the relief hole.

The "Seedy" Special

A 2.5 c.c. Racing Car

by A. F. Fulwood



THE building of this special was started when I had a few weeks' holiday and therefore, ample spare time for model work. Having decided to make another car, the scrap box was searched to find a suitable piece of material for a chassis which would be light yet strong. A short length of 2 in. outside diameter dural tube provided the 1 per cent. inspiration for the job, and from there on the 99 per cent. perspiration started (lathe treadle operated).

It was decided from the outset that the drive should be gearless, i.e. driving wheel fitted directly on the engine crankshaft, since this method had been successfully employed on a previous car powered by a 5.65 c.c. Italian Super Tigre diesel which develops peak power between 5,500 and 6,000 r.p.m. This engine, driving a $3\frac{1}{2}$ in. diameter wheel, produced 54.54 m.p.h. which indicated an engine speed of 5,200 r.p.m. so, allowing for a certain amount of slip resulting from a one-wheel drive, the engine was revving near the peak of its power curve. It was thought that if a tyre of $2\frac{3}{8}$ in. diameter, giving 7 m.p.h. for every 1,000 engine r.p.m., was used for a 2.5 c.c. engine the correct engine r.p.m. would again be obtained.

As I had a 2-c.c E.D. competition special diesel engine which had given excellent performance and reliability in the past, this was the engine decided upon. Accordingly, a mount was turned to fit the end of the tube, to which the engine was fitted, to lie with its cylinder axis along the axis of the chassis tube, so that the carburetter protruded through the side of the chassis. A free-running knife-edged wheel was mounted on a short axle bolted to the engine mounting. The chassis forward of the engine was then cut away for about half its diameter, as shown in photograph and the 10 s.w.g. piano wire front axle fitted. This was clamped in a split-brass block which, when loosened, allowed for steering and vertical adjustment of the front wheels. The 4 oz. driving wheel was machined from solid dural bar, the tyre being a $2\frac{1}{2}$ in. diameter rubber heel clamped between the two halves of the wheel which was turned down to $2\frac{3}{8}$ in. diameter on a mandrel to true the surface.

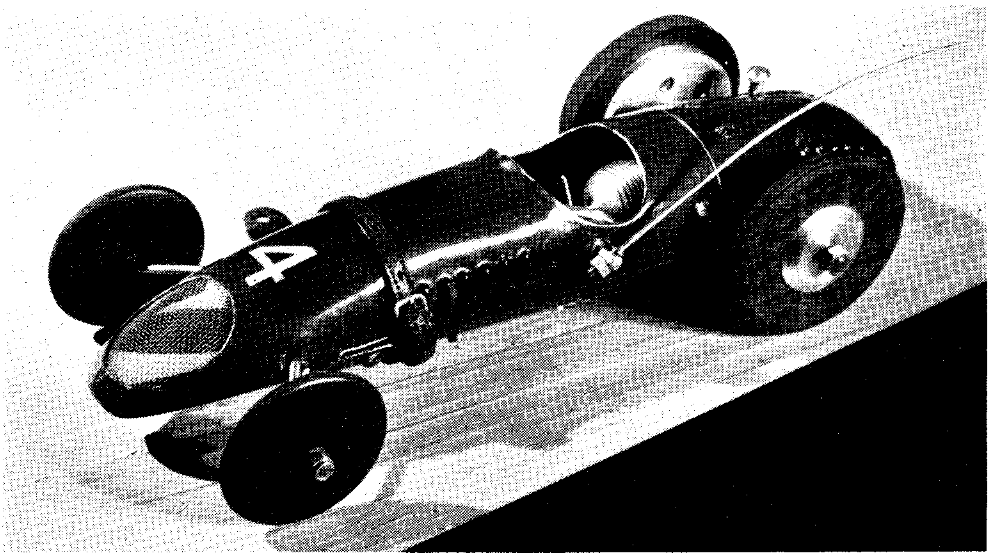
After an aircraft pattern tank, tethering fittings and a rather rough body had been fitted, the car was taken along to the club track one evening for its maiden run. At that time it was run with the driving wheel at the front. The engine started fairly easily and the speed rose to 33 m.p.h. for a couple of laps, after which it dropped again until the car finally stopped in the midst of a small cloud of smoke and fumes, with the engine very hot indeed.

During my summer vacation it was decided to attempt to run the model in the opposite direction, i.e., driving wheel at the rear, and without bodywork. This produced results immediately, due to the much better cooling, and speeds rose to 49.2 m.p.h.

At this time, however, the E.D. engine was continually being transferred from the car to an aircraft and vice versa, so it was decided to fit another engine solely for use in the car and also to increase the capacity to 2.5 c.c. It was therefore

decided to make an engine which was internally identical to an Elfin 2.49 c.c. and to use a commercially-produced cylinder. The crankcase was machined from an odd casting and fixed in the chassis by four radial 4 B.A. bolts, hence obviating the necessity of making a special mount, as had been done in the case of the E.D. An Elfin crankshaft could not be used because the direction of rotation in the car was clockwise instead of anti-clockwise, as in the case of a normal aircraft Elfin, so a spare E.D. crankshaft was ported and fitted. The loose rear axle was screwed into the back crankcase cover. A more respectable bodywork was beaten out of 22 gauge aluminium sheet, sprayed British racing green and finally given one coat of fuel proofing varnish.

The car in its present form has not been completed very long but promises well, having clocked 50 m.p.h. on two occasions recently, and I hope to achieve a little more soon.



L.B.S.C. (*Continued from page* 320)

conglomeration of long rod stays, which are difficult to fit satisfactorily to a round-topped firebox wrapper, but are not liable to waste away and give out. Several cases have come to my notice, of rod stays wasting away in the middle, breaking, and letting the crown sheet down. The whole assembly forms a box girder, which any millwright will tell you, is one of the strongest forms of construction. The Britannia Bridge over the Menai Straits is a box girder. Cut out two pieces of 18-gauge sheet copper to the size and shape shown; bend on the dotted lines in opposite directions, and rivet the longer flanges to the top of the firebox, $\frac{3}{4}$ in. apart, as shown in the cross section of the smaller boiler, and $\frac{7}{8}$ in. for the larger one.

Second Brazing Job

The firebox can now be brazed up, using exactly the same "technique" as described above. Cover all the joints with paste flux, and stand the firebox on end, firehole ring upwards, in the brazing pan. Pack the coke or breeze around it, and put some inside, to within $\frac{1}{2}$ in. of the ring. Start at one bottom corner, after a general preliminary heating, and work your way right around, taking the ring in your stride, in a manner of speaking, when you come to it. Play the flame directly on the joint between ring and doorplate, and run a good fillet of brazing material right around. When through, turn the firebox the other way up, and go around the joint between the side and crownsheet, and the tubeplate. Warning: keep the flame from playing direct on the narrow bits of metal between the tubeholes, or you may suddenly discover one big ragged hole where previously there were several little round ones!

Finally, stand the firebox, right way up, in the pan; put a little more flux along the crownstay flanges, and lay a strip of coarse-grade silver-solder along the inner side of each. Heat up the whole issue to medium red; the silver-solder will melt and disappear into the joint, making the flange to all intents and purposes, solid with the firebox crown, and sealing the rivets. Then, to make assurance doubly sure, as the old saying goes, run some brazing material along the inside of each girder, to form a fillet, as shown by the black triangles in the firebox drawings. Let cool to black; pickle, wash off, and clean up as described above. We are then ready to fit the tubes and smokebox tubeplate.

David Joy

Random Recollections of the "Nineties"—by B.C.J.

THE valve-gear which was evolved from the fertile brain of the personality mentioned above has very frequently been referred to in the pages of THE MODEL ENGINEER and indeed the "gear" has been applied to model engines—both those intended to run on rails as well as those not so intended—in considerable numbers. It may be taken, then, that the model engineering fraternity as a whole are definitely interested in the Joy valve-gear, and accepting this as a true statement may it also not be accepted that some brief remarks regarding the man himself—set down in reminiscent mood—will prove of interest to a good proportion of the readers of these pages.

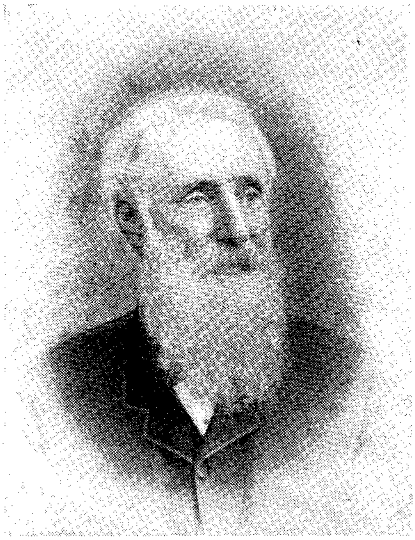


Fig. 1. From a photograph of David Joy taken in the 'nineties

Very well then, let me first attempt a pen portrait of my father at the period to which most of the following notes refer—*viz.* the "nineties." A head of silky snow-white hair worn rather long, a florid complexion contrasting with eyes of light blue—always ready to sparkle with any hint of humour, a long beard not quite of the same snowy whiteness as his hair—but white enough, of medium height and build, wearing always a black coat and grey striped trousers and a black—or sometimes light grey—soft wide-brimmed hat, such as was not uncommon when Queen Victoria sat the throne. And *that* is about the best picture I can give you with my pen, but I would draw your attention to the photograph which appears on this page. (Fig. 1.)

I have suggested by my sub-title that these recollections refer solely to the "nineties" and this in the main they do. I was indeed anxious that personal recollections only should be put on record and that neither history nor "hearsay" should enter into the narrative. But I now see that it will be imperative on occasion to slip back into the "eighties" as well as to look forward a year or two into the present century. I cannot imagine that any reader will object to this process. So I will proceed.

At the period at which my father was connected with The Barrow Shipbuilding Company, he met with a rather nasty accident when skating on Lake Windermere and this deprived him of a good deal of the active side of life. But he took pleasure in the activities of others nevertheless—how eagerly he watched his sons playing football at school, or tennis at the courts at Hampstead, and the bicycle races (penny-farthing) at the Crystal Palace were a source of interest to him. Railway journeys were, as can be imagined, ever popular, and my father would take me with him to Seaford, where at nearby Newhaven could be seen and enjoyed the cross-Channel steam boats—*Paris* and *Rouen*—and the quay-side cranes. Or we would go to Brighton in the spring time, where the Brighton "Works" and Volkes Electric Railway afforded father and son an equal measure of satisfaction. On another occasion we might perhaps journey to Southsea where there were ships to be seen, and the Portsmouth Dockyard; or there might be a little sea travel across the Solent to the Isle of Wight, on one of those very attractive little paddle-boats with their well kept and well handled diagonal engines. And in all these journeyings to and fro, wherever and whenever there was quiet enjoyment to be had, my father cheerfully and smilingly accepted it—as one determined to make the best of life.

How the gear was invented. (**Fig. 2.**)

I do not know. I was not in a position to observe anything at this period of my father's life. In short, I was not born. But much later I had good opportunity for becoming acquainted with my father's methods. He was an expert in the making of card models in the flat and I cannot doubt that, following a few rough sketches—probably pencilled on the backs of envelopes or other scraps of paper—he would devise a model of each link and "pin" it to an adjoining link, using much trial and error in the assembling process. Sections of the valve and ports would doubtless be drawn on separate pieces of card which could be adjusted to suit surrounding parts. And he had a method of making "pin" joints in card models which had no particle of "play" and, with blacklead as a lubricant, worked with silky softness. And so was created a workable model. I have a shrewd suspicion that it was such a model that was placed before F. W. Webb, of North Western fame, when the gear was under

his consideration—for could a straight forward drawing have proved equally convincing? I do not think so.

And here let me add that it may not be generally known that my father had the term of his radial gear patent extended—" they have given me *seven* years " he wired to my mother on this auspicious occasion.

Royalties for the radial gear flowed in pretty freely in the early 'nineties from the North Western and the Lancashire & Yorkshire Railways; and indeed they were needed since there were six of us at home to be provided for—a truly Victorian family.

Another valve gear

Now the life of a patent, even with the referred to extension, does not run to more than 21 years—and time marches on. Thus it was that my father once again got his fertile brain to work and produced yet another valve gear. Under the title of The Fluid Pressure Gear, this device consisted in the main of *two* eccentrics only, each coupled direct to a valve. The eccentrics were provided with hydraulic rams and cylinders and through the medium of drilled holes in the crank-axle and external pipes the eccentrics could be traversed across the axle so as to bring about reversal or variable cut-off. The gear worked fairly successfully, as I shall describe shortly, and in the meantime I wonder whether modern methods of production and modern materials might have rendered this invention quite successful—which it wasn't, also I wonder whether it could be applied to the small scale locomotive—which I doubt.

The " Sussex." Joy Nearly meets with the fate of Huskisson.

The first test of the hydraulic gear was carried out with two sets of gear fitted to a charming little 2-2-2 Brighton engine called the *Sussex*, (Fig. 3), and on one occasion when paying a visit to the Brighton works to inspect some of the parts of the gear before they were fitted, a serious accident very nearly terminated the proceedings. We—my father and I—had left the ramp of the platform and were leisurely crossing the line to the works when an engine and train swept round a curve at some speed and considerable use of the whistle. We were right in the path of the oncoming train and a porter—fortunately on a near-by platform shouted to us " Look out, sir, she's coming there! " Just time there was for us to skip over the rails to safety. Thus was a repetition of the historical Huskisson tragedy avoided and we reached the Brighton works in safety.

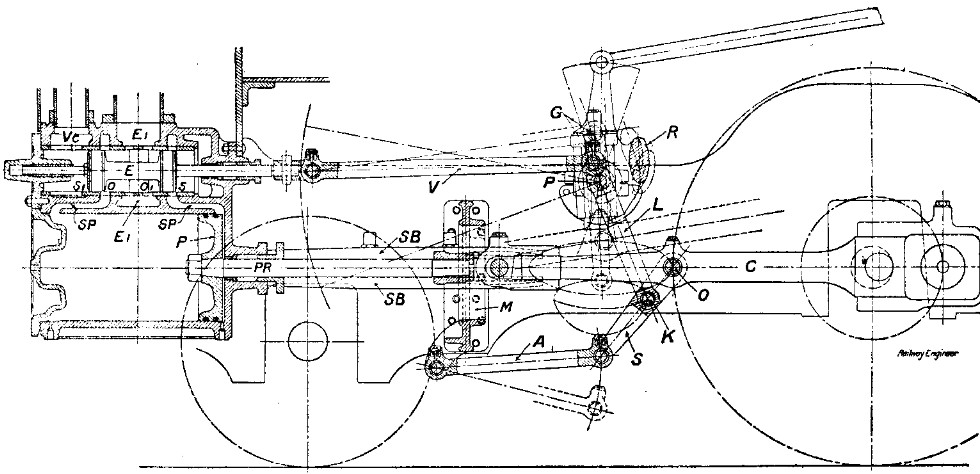


Fig. 2. The Joy valve-gear applied to a locomotive

Later, we made a quite unforgettable little journey on the footplate of the *Sussex* from Brighton to Worthing and back. The odour of warm oil, of new paint, of smoke from the chimney all in evidence and all wafted to us by a gentle sea breeze as we stood, expectant, on the footplate. Altogether a very delightful experience for a lad in his " teens," and my father not at all disappointed with the behaviour of the little Brighton engine.

(I wonder whether " L.B.S.C." has any recollection of the *Sussex*, indeed I sometimes wonder whether he may not have been the driver on this momentous occasion.)

I had the good fortune to accompany my father on many little visits to places where there were engineering interests. To Southampton to get a peep of the engines of H.M.S. *Fox*, the low pressure valves being controlled by his " assistant " cylinders; to Deptford to view some more big engines; to Kentish Town or Chalk Farm to see locomotives and so on. Yes! indeed, those were the days!

The Crystal Palace organ blowers

My father derived very great pleasure from the music of the organ, but of more interest to the readers of these random recollections is the fact, perhaps, that he had invented a hydraulic organ blower. (Fig. 4.) A simple little machine, it was.

its outstanding features being a gunmetal vertical cylinder with gunmetal piston and rod, a valve which reciprocated and was rotated a little at each stroke-end and a simple valve gear, always was there a valve gear be it noted. A short walk round to the back of the organ took one to a view of the "engine-room." There one saw three of these busy little machines, looking extremely attractive in their coats of bright red paint, their polished gunmetal parts, their slow and stately movements and the great bellows above them belching forth air of volume sufficient to keep many of the pipes of the organ fully supplied at one time—and some of them I think 15 *in.* in diameter. Many a time have I stood with my father, intently watching his little machines at work whilst immense volumes of sound proceeded from the great organ in the central transept—playing, perhaps, that very inspiring piece of music by Mendelsohn, "The War March of the Priests" or perchance Handel's "Largo." No wonder that my father loved organ music and no wonder that I developed a similar taste.

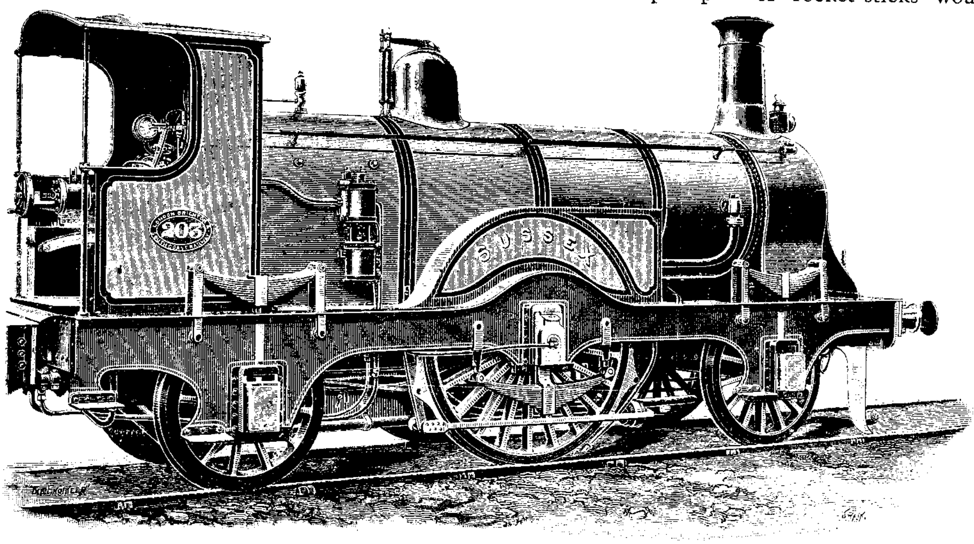


Fig. 3. No. 203 "Sussex," by Stephenson (1864). Rebuilt at Brighton in 1871 by W. Stroudley. Subsequently fitted with Joy's oil valve-gear. (Illustration from "The Engineer")

Fireworks and other matters

Now the organ may or may not have been the *piece de resistance* of the Crystal Palace, but it is certain that there were other attractions such as were of interest to the man whose name appears at the head of this article—the antedeluvian monsters on the lakeside, the balloon ascents and the fountains, the compound steam engine, several times referred to by the writer of these notes, and finally the fireworks. And not least the fireworks!

It was the generally accepted custom to view the fireworks from one or other of the terraces in front of the big glass edifice but my father knew a better view-point—not quite so spectacular, perhaps, but much more thrilling. He took us into the *grounds*! The spot selected being, perhaps close to a point from which a group of shells would be launched into the air, or a flight of rockets, or Roman candles, or some other pyrotechnic novelty. When rockets or shells were to be discharged into the air we all sought shelter and safety under the trees, nevertheless pieces of shell-case would strike the ground near us with a "plomp"—or rocket-sticks would plunge into the soft ground—like spears thrown by an enemy. And this amused my father but alarmed us a little. But my father soon brought the practical side of pyrotechnics into being, for he taught us how to make fire-balloons out of tissue paper and he taught us how to make rockets by wrapping brown paper round a wood former—and these I remember were made in two pieces so as to form a "neck" or choke in the rocket case. With rockets going off at a tangent and fire balloons catching fire a few feet from the ground, our firework displays were the cause of quite enough trouble—and rather more than enough—when on one occasion a rocket fell in the road a yard or two from a mounted policeman!

Joy's many other interests

My father had a number of other interests and interesting things in which we—his children—to some extent shared. A beautiful microscope was one of them and he possessed endless slides of all kinds of botanical and other subjects. And I well remember a Pulex irritans, and this insect magnified about 20 times under the lenses of the microscope presented a really fearsome aspect. There was, too, a telescope in which, the weather being propitious, we could observe Saturn's rings and Jupiters' moons and the mountains of our own moon—and quite a lot of other things. And there was a fine collection of British ferns all nicely mounted and bound into a book of

noble dimensions and provided with a strap and buckle. This was only to be inspected on Sundays and could only be carried by one child with difficulty.

I recollect we were all taught to swim—some of us in swimming baths, some of us in the open sea. It fell to my lot to climb down a few steps from a boat into the sea with a piece of webbing round my chest—my father being of course present—presumably to pull me out if I displayed any tendency to sink But I found salt water surprisingly buoyant—but not at all agreeable to the taste.

Victoria Street and the " nineties "

During this period and indeed a little before my father occupied offices in Victoria Street, Westminister. Here he carried on his consulting business with a staff of three—my brother Basil, myself and a pupil named Burge. Letters were hand-written in those far off days and were copied in a screw-press. The telephone—shared by all—was on the ground floor and the journey up and down was made by a hydraulic lift with a speed of which none could complain. It was in the Victoria Street offices that the designs of the fluid-pressure gear were carried out and the assistant cylinder was developed, and it was here that royalties arrived for the radial gear—mainly from the North Western and the Lancashire & Yorkshire Railway companies—but from others as well. It was at this period that glancing through a newly published book on railways, I came upon a photograph of a locomotive fitted with the Joy gear, to which I at once drew my father's attention. It transpired that no royalties had been received from the builders for some considerable time. A letter to these good people resulted in the receipt of a sizable cheque by my father—and a sizable commission by his son.

My father travelled to and from B. to his office on the London Chatham & Dover Railway. He naturally obtained the maximum of comfort—not much of it though—by travelling *first* class. But unfortunately so did certain Germans, certain fat Germans, certain fat Germans smoking cigars —in a non-smoker, too! How often in the evening did we at home hear a recital of this very disturbing occurrence—and the cigar was generally described " as big as my thumb." However, things went along fairly quietly—in spite of the oversize cigars—in Victoria Street. But there was a cloud on the horizon—the near approach to the time at which the radial gear patent would lapse! A catastrophe indeed! And how was it to be met. In such circumstances my father would—with unshaken faith in himself—remark " Never say die " and thus he took a partner and moved into offices in Gracechurch Street, where he was better situated to encourage the use of the assistant cylinder among shipping people, moreover, he took up an agency for the Aspinall marine governor.

Nearing the end of the road

But with advancing years, the daily visit to the City was proving rather too much of an effort for my father, thus homework at his house in Hampstead became more and more frequent. And since the room which he used as an office looked out over the main line of the Great Central Railway, my father, I think, derived inspiration for his many schemes for improving the efficiency of the railway engine—his first love—from the passing trains, slipping silently down the incline into the London terminus or with harsh barking exhaust making their way to the north.

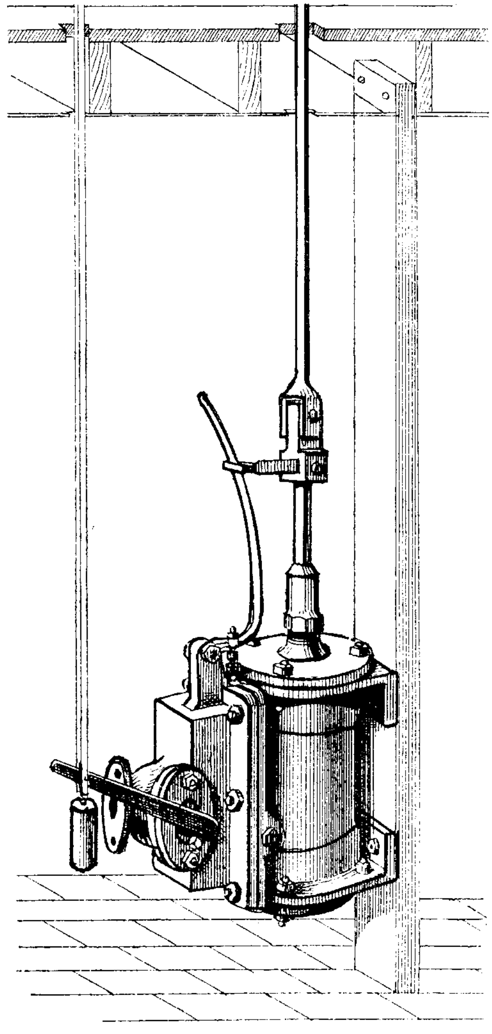


Fig. 4. Joy's hydraulic organ blower—an early model

And thus did David Joy—a man of many inventions—pass the few remaining years of his life. And thus I feel it is time for me to bring these " random recollections " to a close, as there remains to be made a single brief statement only. David Joy's life came to an end on March 14th, 1903, and a stone over his final resting place in Hampstead Churchyard bears upon it the well deserved words " Full of years and Honour."

PETROL ENGINE TOPICS

*A 10 c.c. Twin Four-Stroke

by Edgar T. Westbury

IT has already been mentioned that many of the smaller components of the "Seagull" engine are similar to those of the "Seal" engine, except that the dimensions have been modified. This applies to such parts as the cylinder liners, valve liners, valves, pistons, connecting-rods, etc.; the methods which have been described for the construction of the latter engine are therefore equally applicable in this case. However, there are probably many prospective constructors who have not access to the series of articles on the "Seal" engine, so it will be desirable to repeat the machining operations on these parts.

Cylinder Liners

The material recommended is close-grained cast-iron, and the form in which this is most likely to be available is die-cast stick, as used for making motor car valve guides and similar purposes; this material machines well, though a much lower mandrel speed than is usual for mild-steel is desirable, unless special tools are available. For roughing cuts on the outside of the liners, it is not advisable to run the lathe faster than the highest back gear speed; drilling and boring may be carried out at the lowest direct speed, which may also be used for finishing cuts on the outside. Steel liners are permissible, but are much inferior in wearing properties, and produce higher working friction than cast-iron.

It is advisable to machine the liners from solid material, or if cored stick is used, the hole should not be greater than $\frac{1}{2}$ in. diameter in the rough. Use a length of material sufficient to allow for holding firmly in the chuck, so that the internal and external machining can be carried out at one setting, and the liner finally parted off. On no account should the machined external part of the liner be held in the chuck for boring, or the pressure of the chuck jaws will most certainly cause distortion. These precautions are emphasised, because I find that many constructors encounter trouble through incorrect methods of machining.

It should be possible to machine both the inside and outside of the liner to a good surface finish and parallel within a limit of one or two thousandths of an inch. The allowance for lapping the bore need not be more than 0.002 in. if the above conditions are complied with, and a similar amount may be left on the outside for finishing with a fine Swiss file, or better still, with an external ring lap. On no account should the liner be a tight interference fit in the bore of the barrel casting, or this will introduce stresses which will cause distortion every time the engine warms up; little more than a "wringing" fit is necessary, and the bottom end of the liner may be slightly easier still, so that it can be pushed about half way into the casting by hand. Note that the lower end of the bore is flared or chamfered for about 1/32 in. to facilitate piston assembly; the rim at the top end may be made slightly over length, so that it can be machined flush with the joint face of the barrel after insertion.

Lapping of the bore can also be carried out after insertion, and this process has been described so many times in THE MODEL ENGINEER by other contributors besides myself that repetition should not be necessary.

Valve Liners

These also may be made from cast-iron stick, though bronze is quite a good substitute, and they can be rough turned and drilled at one setting, but a second operation for finishing the outside is desirable, in view of the importance of fitting them properly in the casting. Great care should be taken to drill and counterbore them perfectly truly, as the very slightest inaccuracy in concentric alignment of the bores will result in leaky valves, which are fatal to efficiency, and may even prevent the engine working at all. Start the hole with a centre-drill, entering it deep enough to countersink almost to $\frac{1}{4}$ in. diameter, then follow up with a 3/32-in. drill to full depth and a $\frac{1}{4}$-in. drill to $\frac{3}{8}$ in. depth. The top speed of the lathe may be used for this operation. It is not essential to finish the counterbore to a square angle as shown in the drawing; an ordinary drill point will be satisfactory, but if a proper $\frac{1}{4}$ in. counterbore with a 3/32-in. pilot is available, so much the better. Note that the chamfer for the valve seating is not machined with the valve is first made, as it can be produced much better at a later stage. The top rim may be left slightly over length, as in the case of the cylinder liner, for machining after insertion.

For the second operation on the valve liners, a $\frac{1}{4}$-in. stub mandrel should be turned in the chuck, with a 3/32 in. extension to pass through the valve guide; if desired, this may have a nut fitted to hold the liner firmly, but a good wringing fit should be satisfactory, as this operation should not entail more than a mere skim over the $\frac{5}{16}$ in. diameter and the rim. At the shouldered-down end, neither size nor finish are of critical importance, as this merely forms a guide for the valve spring. The valve liner should be fitted tighter than the cylinder liner—a fairly snug press fit, in fact—and it is most important that it should make contact with the bore of its seating for the whole length, or leakage may take place around

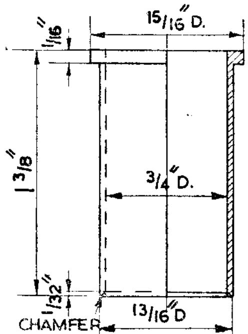
**Continued from page* 236, "*M.E.*," *August* 17, 1950.

the horizontal port, which, by the way, is most conveniently drilled after insertion.

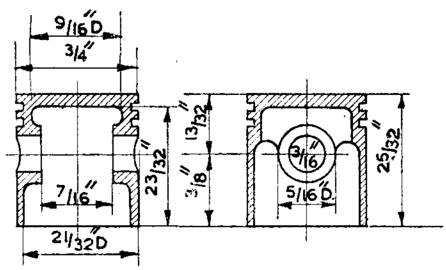
It is good practice to coat the surfaces of cylinder and valve liners, and their seatings, with *thin* shellac varnish before insertion ; this will act as a lubricant to prevent risk of seizure and help to seal any minor leaks, but it should on no account be regarded as a substitute for proper fitting—which it certainly is not.

using the scriber to assist in finding this position, and then produce the lines on the outside of the piston front and back. A point tool in the toolpost may be used to mark the lateral position of the gudgeon pin centres.

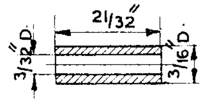
It is possible, by careful centre-punching at the intersection of these lines, and using a small centre-drill as a pilot, to drill the gudgeon pin holes in the drilling machine, to a sufficiently



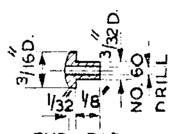
CYLINDER LINER
2 OFF. C.I



PISTON 2 OFF.
C.I. OR L/ALLOY



GUDGEON PIN
2 OF M.S.C.H



END PAD
4 OFF BRASS

Pistons

Since the design for the " Seal " engine was published, the possibilities of obtaining small piston rings have become somewhat brighter, and it is hoped that rings to suit this engine will be available to constructors. In the circumstances, the pistons are shown grooved for rings, though the groove dimensions cannot, as yet, be definitely specified. Most constructors will probably prefer to use castings for the pistons for the sake of convenience, though there is much to be said in favour of machining them from the solid, and it may also be remarked that cast-iron pistons will wear much better, and also give generally better working results than aluminium, in all respects except for high speed and heat transmission, which are, in any case, relatively unimportant on this particular engine.

If piston castings are used, their machining can be facilitated by the provision of a chucking piece, but it is most important that this should not be made an excuse for carelessness in chucking ; the castings should be very carefully set up, checking from the *inside* surface, as this may conceivably be out of truth with the outside and is not subject to correction in the machining process. The fit of the pistons (if equipped with rings) is less critical than in a two-stroke, where they have to serve also as valves, and they may be finished on the outside at a single setting. Cast-iron pistons do not need more than 0.0005 in. clearance, but aluminium will need at least twice this amount, plus further easing off of the lands adjacent to the ring grooves.

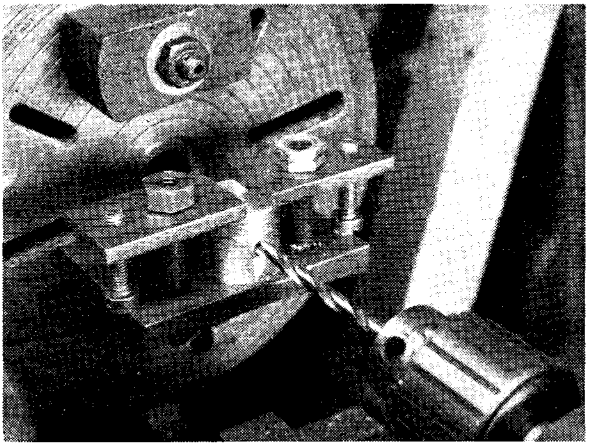
While the pistons are set up for turning, the centre line of the gudgeon pin bosses may be marked off with a scribing block on the lathe bed, set exactly to centre height. Turn the chuck so that the bosses lie across the horizontal diameter, close limit of accuracy for practical purposes, though much more positive accuracy is obtainable by mounting them on an angle-plate as shown in the photograph. It is unnecessary to machine the inside faces of the gudgeon pin bosses, as end clearance is allowed over both sides of the connecting-rod little-end. The holes should be drilled with a No. 15 drill and finished with a $\frac{3}{16}$-in. reamer.

For accurate finishing of the pistons, especially when very fine clearances are required, the lapping of the external surface by means of a ring lap is recommended. As I have not illustrated this process before, I have taken a photograph showing how the piston, mounted on its connecting-rod, or a temporary holder, may be applied to a split ring lap, held in the chuck and adjusted by tightening the chuck jaws.

The gudgeon pins, which are fitted with soft brass or aluminium rubbing pads at each end, are quite simple and call for little detailed comment. It is permissible to use precision-ground $\frac{3}{16}$-in. mild-steel rod to save machining the outside ; after drilling and facing, this should be case-hardened on the outside, and finally polished. The end pads should fit tightly in the bore of the pin, and before assembly, ascertain by means of calipers that the measurement over the ends of the pads is slightly less than the piston diameter. It is advisable to fit the pin slightly on the tight side in the piston bosses, so that it is not too slack when expansion has taken place at working temperature.

Connecting-rods

The cast bronze rods recommended give very good results at any speed likely to be required of this engine, but duralumin rods, machined from the solid, may be preferred by fastidious construc-



Piston set up on angle plate for drilling gudgeon-pin hole

tors, and is better if consistently high speed is intended, though the bronze rod stands up to more than 8,000 r.p.m. With a rod having a split big-end, the most important thing is to fit the joint properly, by ensuring that the contact surfaces are perfectly flat and the bolts or set screws are of sound material, closely fitted in the holes to serve virtually as locating dowels. Contrary to popular opinion, it is *not* necessary to screw these bolts up with all the force at one's command (providing the above conditions are complied with), and to do so only puts excessive tension on the bolts, over and above that which they are intended to withstand. Mild-steel bolts and screws are definitely not good enough for this duty, in such a small size, and the material I always recommend is a piece of spoke from a motor cycle or motor car wire wheel, which is specially designed to resist tension. Do not be tempted to use silver-steel, which is much too brittle, but a high tensile aircraft bolt may be turned down and used for the purpose, and such bolts are readily obtainable nowadays.

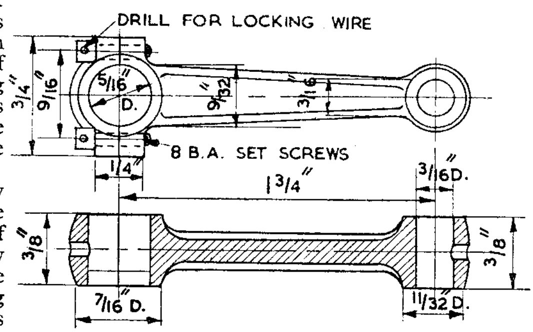
In machining the bronze casting, the hole for the big-end should first be rough drilled, and the eye sawn through on the joint line. The two parts are then machined perfectly flat by holding each in turn in the four-jaw chuck and using a facing tool ; the set screw holes are then drilled and tapped, and any burrs or other irregularities removed from the machined surfaces, which should then be tested on a surface plate, and, if necessary, scraped or lapped true. A spot facing cutter should be used on the outside of the holes in the loose cap, to ensure a true bearing for the screw heads. Temporary screws may then be fitted to hold the cap in place for machining.

The rod may now be set up in the four-jaw chuck, with one jaw reversed, to enable the eye of the rod to be set centrally. Check the faces of the big- and little-end eyes to ensure that they are square in both planes. Face the end of the boss and open out the hole with a small boring tool to $\frac{5}{16}$ in. diameter, taking care to obtain as high a finish as possible in the bore ; a reamer may be used for finishing if desired, but should only be used to take out a mere scraping of metal, or there is a danger that it may snatch or chatter, thereby producing a hole which is anything but circular. Chamfer or radius the mouth of the bore, and at the same setting, a cut can be taken over the outside of the boss, as far as the sides of the rod will allow, using a round-nosed tool and setting the top slide to about 10 deg. taper. The other side of the boss may be similarly treated, and also faced on the end, by mounting the eye of the rod on a stub-mandrel.

To machine the little-end eye, a very good method is to use the four-jaw chuck, with one jaw removed and replaced by a locating mandrel. The latter may be made in the form of a tee-bolt, with its head shaped to fit the jaw slot, and the shank turned to fit closely in the bore of the big-end eye, or fitted with a concentric sleeve if the latter is impracticable. A distance bush will be required to pack the rod out from the chuck jaws, into a suitable position for working on the little-end, and this bush should be of ample outside diameter to bed down firmly on the chuck face ; a nut and washer is provided to clamp the big-end. The little-end boss is centred by means of the three chuck jaws, before tightening the bolt, and this method gives positive assurance that the bores of the two eyes are in exact parallel alignment.

As in the case of the big-end eye, boring, facing and cleaning up the outside of the boss may all be carried out at one setting, after which a stub mandrel may be used for facing and turning the other side.

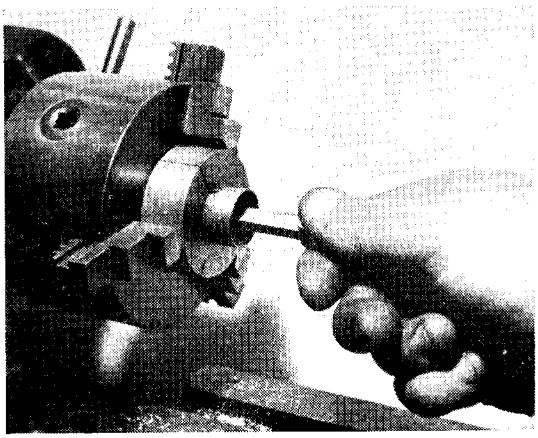
If the rods are made from castings, no further machining operations on them are necessary, but they will need cleaning up on external surfaces with a file and emery-cloth to remove rough edges and produce a neat, presentable finish. For rods machined from the solid, a milling operation to produce the fluting of the webs is desirable, though not an absolute necessity, as the amount of metal removed in this way hardly makes much difference to the unbalanced weight, especially when light alloy rods are used. The two rods should be identical in dimensions,



CONNECTING ROD 2 OFF BRONZE

especially in the centre distance between the eyes, and also in weight.

The material recommended for the valves is stainless steel, or any approved valve steel ; the stems of old motor car valves, which are usually obtainable from the local garage, will serve quite well, but some of these are not too easy to machine and call for good tools, kept keen and properly set. A sufficient length of material should be allowed for a chucking piece, so that the entire valve can be machined at one setting, except for facing the head after parting off. Turning the stem and the head at different settings is not advised, unless one has a collet chuck which can be guaranteed perfectly accurate.

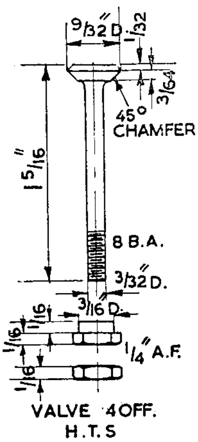


Lapping the piston by means of a split ring lap held in the three-jaw chuck

Some constructors may find it difficult to turn down the slender valve stem, but it can be done with care and patience, plus proper tools as mentioned above. It is a good idea to turn down the threaded portion of the stem first, leaving all the rest full stock diameter, then carefully chamfer the end to 60 deg. included angle (the use of a hand tool is the quickest method) which will then enable it to be supported by a hollow centre in the tailstock. Run the lathe at top speed, and turn the stem down with light cuts, using plenty of lubricant. A round-nosed tool of small radius is recommended, with plenty of top rake ; this will produce a good fillet under the head, but do not try to form this by pushing the tool hard up to the shoulder, or it will very likely dig in.

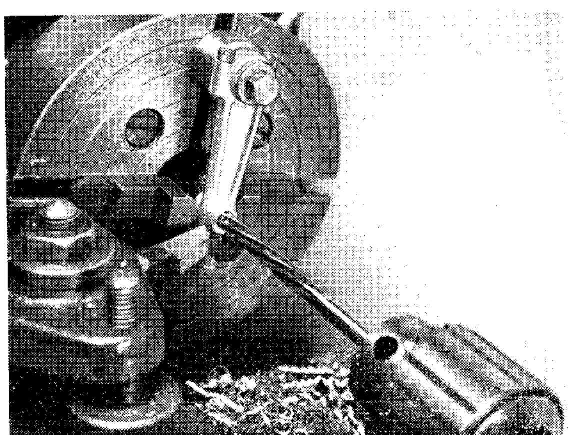
The finish of the stem should be as smooth and accurate as possible, so that it fits the guide perfectly and works with minimum friction. Badly fitted inlet valves allow of air leakage which is fatal to good carburation. I usually finish the surface of valve stems and similar parts with a fine India oilstone—not a Swiss file and emery-cloth as sometimes recommended. The seating faces of the valves should be turned by setting over the top slide to 45 deg. and taking the same trouble to produce a good finish. On no account should the seatings be formed with a broad angular faced tool, as this is liable to produce a wave or chatter which is fatal to proper seating of the valve.

The use of screwed valve stems has been criticised, but although it is admitted that this method of securing the springs is rarely used in full sized practice, it has proved perfectly satisfactory in three of my previous engine designs and is much the simplest to apply to very small valves. Of the " orthodox " methods of retaining the springs, slotting the stem to take a substantial cross key is almost impracticable, while grooving the stem for split cotters would be liable to weaken it ; and assembly of the cotters would call for scale model fingers, or the assistance of trained



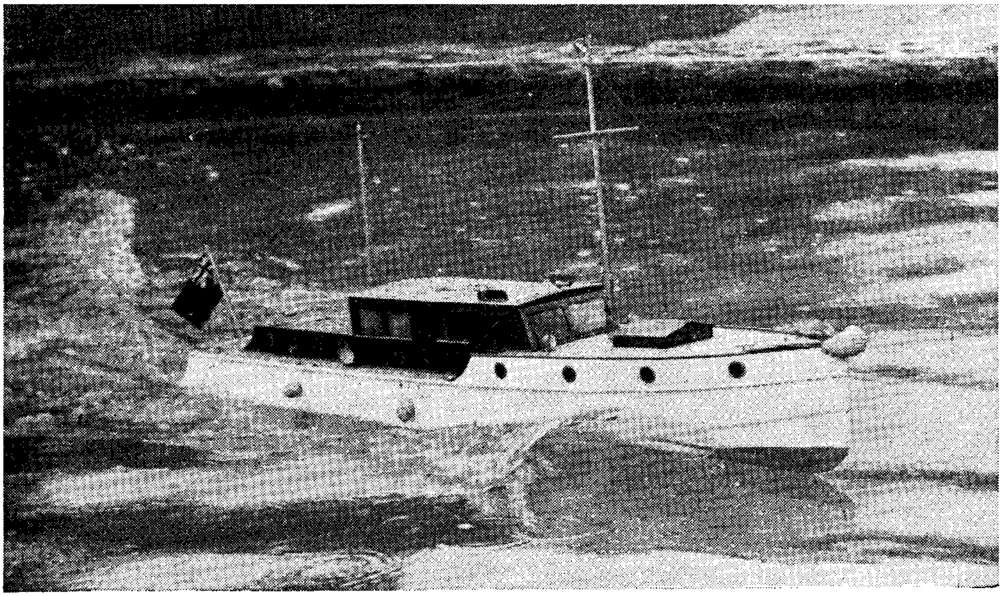
ants, whose multiple digits would be most helpful in such an operation ! To paraphrase the words of the ancient warrior, whose shrewd utterances were immortalised by Captain Bruce Bairnsfather—" If you are cognisant of a superior aperture, proceed thereto ! "

(To be continued)



Method of setting up connecting-rod for boring little-end eye

The Guildford Regatta



The veteran cabin cruiser " Slickery," by Mr. R. O. Porter, in the nomination race

STOKE Park, Guildford, was the scene of the annual regatta promoted by the power boat section of the Guildford Club.

Held a week or two earlier than usual, the regatta drew a fine attendance, but it has to be stated that Guildford's reputation for " fine weather " regattas has gone by the board.

The start of the regatta was delayed by persistent rain, but at last it eased sufficiently to enable a start to be made.

The first two events were for the steering boats, a Nomination Race, followed by the Steering Competition.

The Victoria Club was present in full force, and many of their well known prototype boats took part in these two events. This regatta marked the appearance of a fine new tug by R. Brown of this club. It is called *S. A. Everard*, and is a fine scale model of the full size vessel of the same name. This boat, besides looking good, won the steering competition, although her builder was not there to see it, being unable to be present. On this occasion it was run by J. B. Skingley the Hon. Secretary of the Victoria M.S.C.

The nomination event was won by A. Rayman (Blackheath) with *Yvonne* and T. Curtis (Victoria) running up with *Micky*. B. Whiting (Orpington) ran a new boat in these two events, a striking steam launch, but the steering qualities will need adjustment for future regattas.

The 8 lap (600 yd.) Class " A " Race started off in very fine style, almost all the boats finishing the course, and several at good speeds. E. Clark (Victoria) with *Gordon 2*, recorded 47.9 m.p.h. B. Miles (Kingsmere) *Typhoon*, 48 m.p.h. K. Williams (Bournville) *Faro*, 48.3 m.p.h. On the second round, none of these speeds were improved upon, except that B. Miles managed to get a fine run with *Barracuda* at 52.9 m.p.h., which made him the winner of the " A " class race. B. Pilliner (Southampton) was unlucky on both attempts with his flash-steamer *Ginger*, and also E. Walker (Kingsmere), with *Gilda*, did not finish.

In the 4 lap (300 yd.) Class " B " Race, G. Lines's *Sparky II*, which has been recording 56-57 m.p.h. at regattas recently was well below form ; 44.7 m.p.h. was the best it could do on this occasion although the short course (75 yd. per lap) may have been partially responsible. F. Jutton's *Vesta II* was also a little below form although it was really travelling on the second run when it dived " below." The first run, however, was nearly as fast as *Sparky II*, recording 43.8 m.p.h. N. Hodges (Orpington) with *Sparta* was also running slower than usual, 32.6 m.p.h. being the best run.

The 4 lap Class " C " Race was not as interesting as the previous events, as only one boat completed the distance. This was B. Miles's *Dragonfly* which did 38.5 m.p.h. All other entries failed to finish, either capsizing or engine failures being responsible.

Finally, a 4 lap Class "D" Race saw C. Hancox (Kingsmere) win the race with *KM3*, 30.8 m.p.h. F. C. Walton ran two boats in this race, but only one, *Lucy*, completed the distance, *Jolt* capsizing on both attempts.

Results

Nomination Race—1. A. Rayman (Blackheath) *Yvonne*: error .6, % error 8.6. 2. J. Curtis (Victoria) *Micky*: error 1, % error 14.3.

Mr. E. Clark (Victoria) starting "Gordon 2"

Steering Competition—1. R. Brown (Victoria) *S. A. Everard*: 8 pts. 2. W. Gates (Victoria) *Squib* 2: 6 pts.

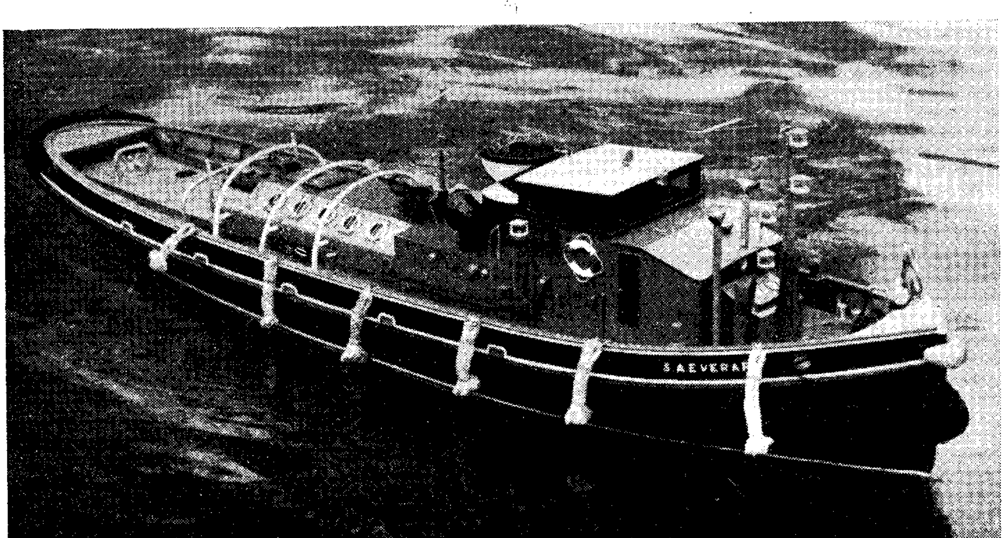
600 *yd. Class "A" Race*—1. B. Miles (Kingsmere), *Barracuda*, 52.9 m.p.h. 2. K. Williams (Bournville), *Faro*: 48.3 m.p.h.

Mr. B. Pilliner (Southampton) with his "A" class flash steamer "Ginger"

300 *yd. Class "B" Race*—1. G. Lines (Orpington), *Sparky II*: 44.4 m.p.h. 2. F. Jutton (Guildford), *Vesta II*: 43.8 m.p.h.

300 *yd. Class "C" Race*—1. B. Miles (Kingsmere), *Dragonfly*: 38.5 m.p.h.

300 *yd. Class "D" Race*—1. C. Hancox (Kingsmere), *KM3*: 30.8 m.p.h. 2. F. Walton (Kingsmere), *Lucy*: 28.5 m.p.h.



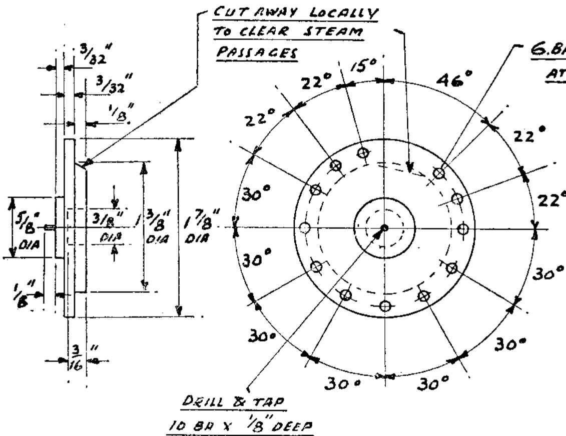
A new petrol-driven tug by Mr. R. Brown (Victoria), the "S.A. Everard"

*TWIN SISTERS

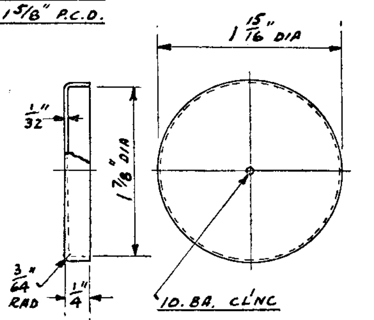
by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally, but very different internally

WITH regard to the cylinder casting, the first job is to remove any sand and to examine it for flaws and blow-holes; most suppliers have a careful check over castings before dispatch since, naturally, they do not want to have any materials sent back to them for exchange. Nevertheless, it is always a good plan to do your own systematic examination, as there is nothing so exasperating as having a casting nearly completely machined and then discovering some flaw serious enough to scrap the whole job. Some defects can only be disclosed in the machining process, and I know of no method of testing parts for hidden flaws, except the radiological method, and that is hardly likely to be within reach of the average locomotive man.



FRONT CYLINDER COVER. 2 OFF.
HANDED — LEFT HAND DRAWN



FRONT COVER. 2 OFF
IN STAINLESS STEEL OR DURALUMIN

Boring the Cylinders

My method of boring and machining cylinders is to do the actual bore first, making this the datum from which all other machining operations are measured. There are four really important dimensions to watch, all of which are inter-related and will affect the ultimate good working properties of the finished unit. First, the cylinder bore: in the case of a pair of cylinders, these should be equal in diameter which is far more important that the diameter itself, so that if the first cylinder by some mischance, comes out 1/32 in. above or below the required size, then the second cylinder must be made to correspond exactly.

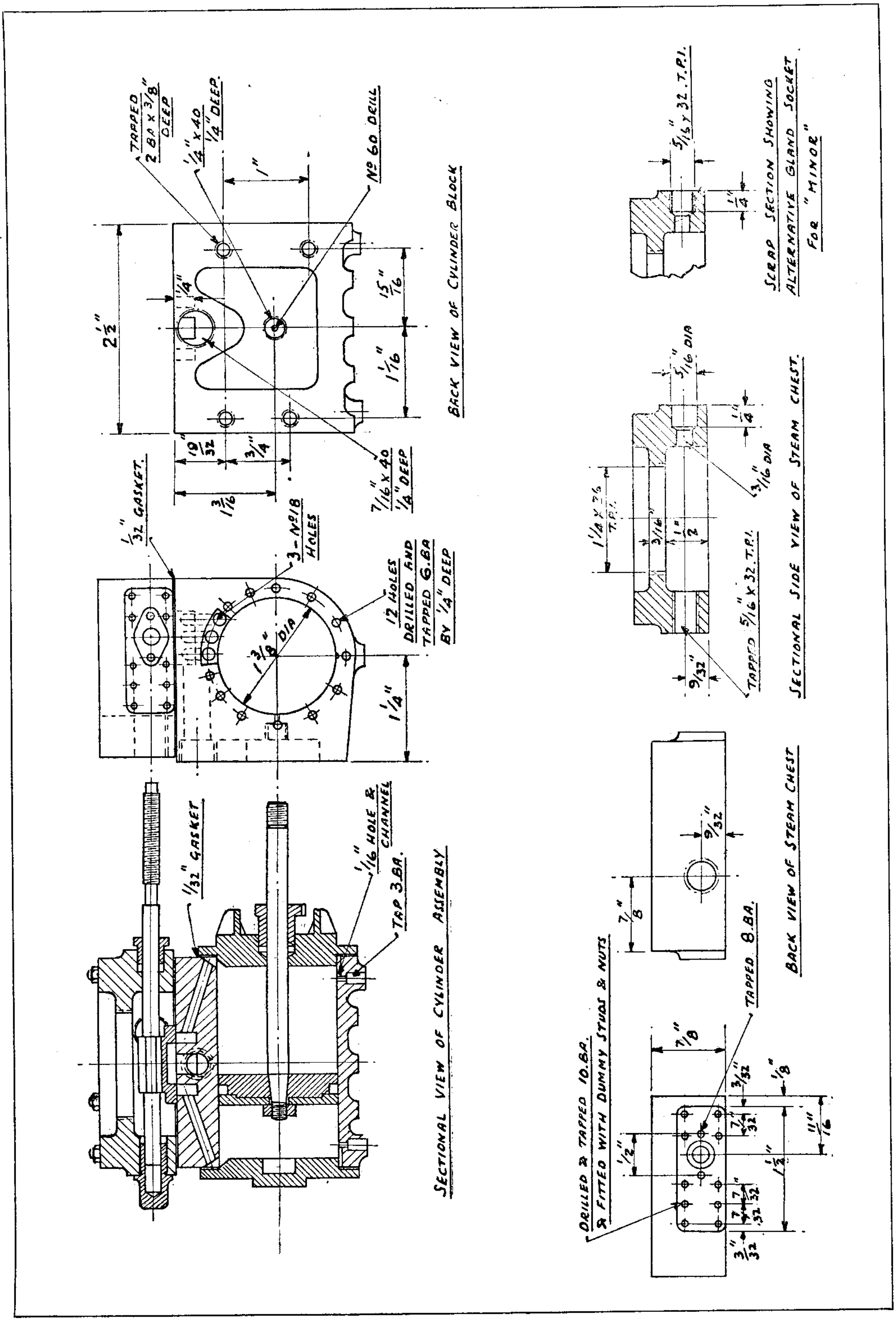
The bores *must* be quite parallel—quality of finish takes second place here, within reason of course. Once the bores are done, the dimension from the centre of the bore to the bolting face of the block is quite important, but perhaps not quite so important as the bore centre to port face dimension. The greatest danger with both these faces is when they fail to run parallel to the bore—then the most frantic errors creep in, due to the insidious and cumulative angle error that causes the valve-gear to slope up, down, in or out, or with a combination of two of these, relative to the cylinder bore (I was going to say *four* of these—I have seen engines that really did look as though this had been made possible.)

Finally, the length of the cylinder block and with the same proviso regarding the truth of both these faces; well, there we have the entire case, so let us set about getting a couple of reasonably true cylinder bores, equal in diameter.

The Boring Bar

The time-honoured and much-extolled virtues of the boring bar, run between centres, is worthy of attention. The theory is simple enough—if a tool point is revolving about a constant and fixed arc, and the work is travelled past it, the result (in theory) is a perfectly parallel cut. But there are pitfalls of a very common and usual nature; for example, if the saddle of the lathe is not correctly adjusted, and is capable of being lifted up and down—only a little, perhaps, just a tiny shake, and the tool in the boring bar is not quite correctly ground, and rubs a little, then the chances are that you will produce a

*Continued from page 196, " M.E.," August 3, 1950.


SECTIONAL VIEW OF CYLINDER ASSEMBLY
BACK VIEW OF CYLINDER BLOCK
SCRAP SECTION SHOWING ALTERNATIVE GLAND SOCKET FOR "MINOR"
SECTIONAL SIDE VIEW OF STEAM CHEST.
BACK VIEW OF STEAM CHEST
TAPPED 2 BA × 3/8" DEEP
1/4" × 40 1/4" DEEP.
No 60 DRILL
7/16" × 40 1/4" DEEP
1/32" GASKET.
3-No18 HOLES
12 HOLES DRILLED AND TAPPED 6.BA BY 1/4" DEEP
1 3/8" DIA
1/16" HOLE & CHANNEL
TAP 3.BA.
DRILLED & TAPPED 10.BA. & FITTED WITH DUMMY STUDS & NUTS
TAPPED 8.BA.
TAPPED 5/16" × 32. T.P.I.
5/16 × 32. T.P.I.
1 1/4 × 26 T.P.I.
5/16 DIA
3/16 DIA

perfectly parallel and *oval* bore. The remedy is to see that the saddle can be moved in one direction only, that is, along the lathe bed. With these conditions obtained, and a tool point carefully ground, you should get a good bore.

Chuck or Faceplate Boring

If you are fortunate enough to possess a good stout, accurate lathe, or accurate enough to ensure that the saddle does slide (without shake) along the bed, and that the headstock is truly in line with the bed, you can bore parallel cylinder bores.

Any pitfalls here ? Yes, I'm afraid there is still one snag left sticking out, and that brings us to the point of the cutting tool once more. I recall an instance that came to my notice some time ago. A man bought a good make of lathe, mounted it correctly, and started to do some turning. Everything went well until he tried to bore a couple of long, cast-iron bearings, and these persisted in a marked degree of internal taper. After trying to " adjust " the lathe, in the process of which he produced some very remarkable results, one of these being a genuine " Morocco " finish imparted to a short length of quite harmless brass bar, he wrote to me, asking me to check the lathe for him.

I went over, complete with checking gear, and finally got the lathe back to something like its former accuracy ; when I had finished some simple turning jobs, I asked him to let me have a try with his cast-iron bearings. Putting the boring bar back in the toolpost, exactly as he had left it, I took a cut, followed by another but without advancing the tool ; I repeated this about half a dozen times, all without advancing the tool, and still removing quite a lot of metal each passage to and fro. In short, this fellow had a very fair idea on how to grind a tool for outside turning, but when he came to boring tools, he could not quite get the right idea on clearances.

That was a story with a happy ending, because I put him on the right lines before I left. I presume he bored the cast-iron bearings in a satisfactory manner, because I didn't hear from him again.

Moral—there *is* a moral, and I have not laboured a simple story for nothing—*every* cutting tool, or rather, single-pointed tool indulges in some away thrust from the work, even when perfectly ground and lapped, and there is only one factor to counter this reaction to cutting—stiffness in the boring tool or bar, *and* its mounting, and general rigidity in the machine itself. That is why I mentioned a stout as well as accurate, lathe. Therefore, use a boring tool as large as can conveniently be introduced into the core of the cylinder bore, and keep the overhang of the tool right down to its bare minimum.

As for the cutting edge of the actual tool-bit, you can do much to reduce away thrust by accentuating the angle of top rake (or lip), reducing the *width* of the cutting edge, and employing a really fine auto feed, and making sure that the " heel " of the tool does not rub underneath. *Any* shape of tool does to rough out the initial sandy bore, but the finishing cuts should be made with a tool ground as suggested, and with the very final cuts down to a mere thousandth or so.

Measuring the Bore

Here is a way of making up a simple tool that will ensure your getting two cylinders of exactly the same diameter ; not only that, you will have also another tool to enable you to carry out further turning operations. Before mounting the cylinders for machining, take a piece of mild-steel bar, about 6 in. long, by $1\frac{1}{2}$ in. in diameter. Face both ends, centre substantially, and mount between centres.

Turn down about 4 in. of the length to $1\frac{3}{8}$ in. diameter ; if you have a 1 in.-2 in. micrometer, this is quite easy ; if you have no measuring instrument large enough to do this, just set a pair of outside calipers as near as you can.

If the diameter of the turned part at the shoulder end finishes up a thou. or a thou.-and-a-half " up " on the other end, leave it, but finish off the work to a good smooth surface with either a very fine file, or emery-cloth on a stick.

If the turning does not produce any taper, then you will have to achieve one artificially, using once more a fine file followed by emery cloth.

You are now all clear for the cylinder boring, and you will be able to use the piece of steel as a gauge which, with its very fine taper will begin to enter the bore when are you within a thou. of the desired size. If you intend to lap the cylinders, then this method will hardly do, as more than an odd thousandth should be left for lapping—something nearer to three thousandths is the ideal, to make sure of getting all machining marks out.

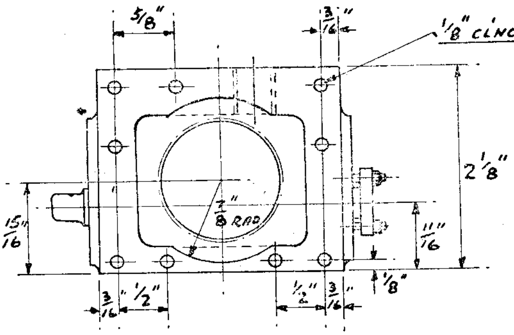
You have then, two alternatives—to bore the cylinders so that they will *not* go on the turned mandrel, later, lapping them out until they *will* ; or, turning the cylinders to jamb lightly on the turned mandrel, leaving the lapping until the remaining machining operations are completed ; there is really nothing much to choose between the two methods, except that the present example is based on the latter procedure.

Getting back to the lathe, you should now have a couple of cylinders that fit with equal tightness on the mandrel turned up, and which you can now put into service for dealing with the facing of both ends of the cylinder block ; this is the 100 per cent. method of getting these end faces true to each other, and to the bore itself, at the same time making it an easy matter to measure the length of the block.

Bolting and Port Faces

Now we have a complete change of scene ; we want a faceplate on the lathe, and one that turns quite truly and is flat into the bargain ; without these two conditions fulfilled, it would be useless to continue in the hope of getting accurate results.

If it means refacing the faceplate by taking a turning cut over it in position, then do so ; to this we will bolt an angle plate, if possible no bigger than is necessary to accommodate the cylinder block when stood on end. The plate must have two flat faces, quite square to each other, which sounds simple enough, and what one might rightfully expect when getting one from the tool stores. But, just in case, check it, first of all on the bench, and then when bolted to the face-

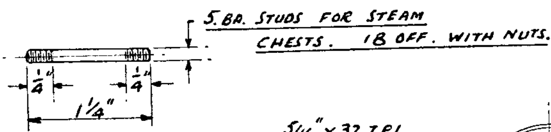


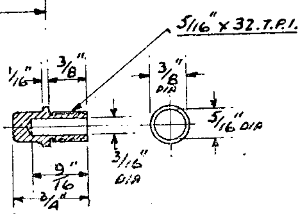
PLAN VIEW OF STEAM CHEST
(SCREWED CAP REMOVED)

plate. The best way of doing this is to mount a dial-gauge or its equivalent, in the toolpost, and with the lathe stationary, run the gauge over the surface, using the saddle to provide the travel. I am not worrying about the odd thou., or half thou., but something more severe—I did find one with a fat 1/64 in. in the course of my travels.

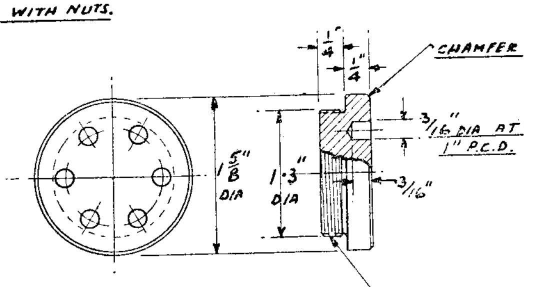
Now mount one of the cylinders on the angle-plate, using a long bolt through the bore, and a stout bar across the top. A complete washer on the top, has the disadvantage of hiding the edge of the bore, and you will want to take your measurements from this edge. All you have to do now is to face off to the required dimension, which you can work out from the drawing.

When this has been done, the cylinder can be turned round and the machined face squared off with the surface of the faceplate, so presenting the other flat face to the front, ready for machining. With these manoeuvres over, the main work on the cylinders is complete, leaving the milling





STEAM CHEST FRONT GUIDE
2 OFF — IN G.M.



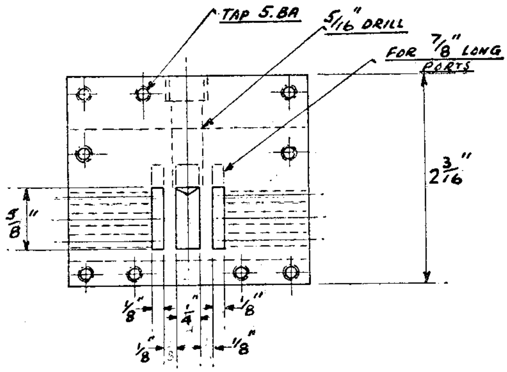
STEAM CHEST CAPS. 2 OFF.

out of the ports, and the drilling and tapping of a number of holes.

I have had one last thought on the matter of cylinder boring—something that the experts will take in their stride without even giving it a thought, but it might be as well to give the less skilled people a gentle hint. When setting up the cylinder for boring, bring up the back centre close to the work, and with a steel rule, check that the cylinder position will allow enough metal to be left on the port and bolting faces for machining off later. In other words, start the bore position correctly, relative to the two faces mentioned, regardless of how the cored hole in the casting runs.

Machined versus Lapped Bores

So far, no mention has been made of the alternative metals that may be used for the cylinders, and quite naturally, their treatment varies. Taking cast-iron first, and giving my own particular views on the subject, I will present the case in the following way:—If you intend to use



PLAN VIEW OF CYLINDER BLOCK FACE

piston-rings, a really good smooth bore, without lapping, is all that is necessary although a lapped bore might give sweeter running in the early stages. One advantage of the unlapped bore lies in its ability to "hold" a film of oil, or better still, colloidal graphite which I always use when running-in cylinders made from cast-iron or Meehanite. It is surprising how soon the bores attain their own high degree of finish and hardness, harder, I think, than in the case of the lapped bore, whilst the pistons and rings do seem to have a longer life where no lapping has been carried out. I have a suspicion that it may be due to minute particles of abrasive being retained in the bore surface.

If I were about to lap a cylinder, I would make

the abrasive "captive," much as the "Delapina" folk turn out their standard honing sets, with a cemented abrasive stone strip held in an expanding metal frame. This puts me in an awkward spot when it comes to telling builders how to do this without the aid of the proprietary article mentioned, and as I have no idea (without going to loads of trouble), it must be left at that.

Failing the captive stone method, I might use one of the water-soluble lapping compounds (there are a number of these, I believe, although I have no information on the point), and hope for the best.

Bronze or gunmetal bores should not need lapping or honing in any case, and part from the far greater risk of providing lodgment for abrasive, what a good boring-tool or properly used reamer will not do, could hardly be improved upon by lapping, unless there is some degree of taper to be got rid of.

Steam-chests

Before the chests themselves are tackled, you should make the screwed caps that go into them. Set up the lathe for 26 threads, turn and screw the threaded portion, and turn the edges and under the head, but leave the head top and the spigot provided.

There are two small points to watch. Point No. 1, put a relieving groove for the thread to run into, just under the head, and not much deeper than the thread root diameter. Point No. 2, when you turn the portion under the head, where it will seat on the steam-chest, undercut this on an angle, to give it a concave rather than a convex face; this prevents the gasket being spread or squashed out when the cap is tightened down.

By doing this work on the cap first, you will find it easier to fit it to the thread when you come to screwing the chest portion in the lathe; a moment's thought should make this quite clear. The drawing calls for two caps, but I advise you to make up three; you will need one later on for the fitting on the dome, for general boiler access, and as all three are exactly alike, it will certainly save time later.

Back to the steam-chests; on either the faceplate, or held in the four-jaw chuck, face off the tops of both chests. Now both may be replaced in turn on the faceplate, holding them down by a short bridge-piece placed across the inside of the recess in the casting, where the screwed cap will eventually go. I advocate the machining of all the edges of the chests, even if only to give the parts a good, clean appearance. For this operation you may again make use of the angle-plate, which is as convenient and quick as any other method, and more accurate than most.

When all the outer faces and edges have received treatment, replace each chest on the faceplate, top face outwards, and with the centre screwed cap aperture positioned as shown on the drawing, and disregarding the running of the cored hole.

Bore, face and counterbore where it runs out into the square box section of the upper half of the chest, and if you have left the lathe set up for 26 threads, then you are all set up for cutting the thread, chasing out until the cap will just screw in comfortably. When the cap has been made to go right home, leave it in place, and at the same setting, face off the chucking spigot, and bring the head down to thickness, not forgetting to put the chamfer round the edge. There is no need for the immediate removal of the screwed cap, the whole job can now be taken off the faceplate, when the six spanner holes in the head can be marked off and drilled; alternatively, this job can be done with the unit still in the lathe, and lucky folk with headstock dividing-heads and a drill spindle to mount on the toolpost, may prefer to do the job in this way.

The next machining operation is to drill or bore the spindle holes and gland socket. For "Major," the oval stuffing-box gland is recommended, but there is a simple alternative shown on the drawing for those who prefer the screwed type of gland. I prefer the flange type myself, not only because it conforms to the prototype, but because I think it is so much neater and very effective.

Screwed glands are usually drilled, turned down, and then threaded with a die, the assumption being that perfect concentricity must follow. I do not agree; a good, sharp die may well do this, but when it begins to cut just a little more freely on one or other side, then there is likely to be a little bias in the run of the thread. Screw-cutting, especially on gunmetal is so simple that I wonder more folk do not go to this extra trouble.

(To be continued)

Stourbridge Rotary Club Exhibition

MR. R. S. MANTLE, hon. secretary of the Hobbies Hall Committee of the Stourbridge Rotary Club informs us that there will be a Hobbies and Handicrafts exhibition in the Stourbridge Town Hall from October 24th to 28th next. The committee hopes to make this as attractive as possible to the greatest number of youths of the Midlands, and especially to all those whose hobby takes them into the field of modelling of any sort. Valuable prizes will be offered for entries in the competition section.

This seems to be a very commendable venture, and we hope that it meets with every success. Meanwhile, we are sure that Mr. Mantle will be pleased to give all desired information; his address is: "Bryn Deryn," Worcester Road, Oldswinford, Stourbridge, Worcs.

Workshop Power Supplies

by D. Blackhurst

A LARGE number of our readers regard electricity as something that is useful and needs no attention. Many workshops have lathes and machine tools which are beautifully looked after, but often the wiring to the motor is an odd piece of flex run from the lights. Most motorised machines which are purchased direct from the makers have a combined fuse box and switch, but if they are not so fitted it is well worth while to make up a block as shown consisting of a 6 in. × 3 in. switch block with a pair of fuses, preferably of the cartridge type, and a switch. Switches and sockets for plugs should always be purchased from a reputable dealer and are best made of a porcelain base with a plastic cover. The fuses should preferably be of the sliding type fitted with cartridge type fuses. For motors up to a ¼ h.p., 5 A fuses are ample, but for larger sizes it is best to use 10 A fuses, as the heavier starting current of these motors is liable to blow 5 A fuses.

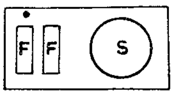
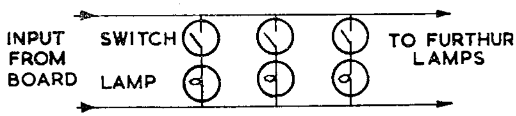


DIAGRAM OF FUSE AND SWITCH BLOCK

All my motors are wired up to a main fuse board which will be described later. As for light, this again is run off a main board and consists of one sixty watt lamp for every 100 sq. ft., coupled with extra lamps over the drill and lathe. The lamps should be connected in parallel as shown with a switch in each circuit.



The best method of wiring these lamps is to run a conduit pipe all round the workshop with T-boxes at frequent intervals. If ⅜ in. conduit is used all the wire for the lighting and for machines may be run through the same conduit, although it must be noted that separate circuits should be run for the lighting and machines, as the slight economy in wire where running them all off one circuit is offset by the extra expenditure of buying the heavier gauge wire necessary to carry the increased current. For lighting, which by the way should be fused at the main board with 5 A fuses, it is best to use 7.029 stranded wire, preferably rubber covered (double). Machine motors vary greatly in their rating but the manufacturer will gladly advise as to the wire to use. As for earthing, this is not necessary with lighting, but all machines should be earthed directly onto the conduit, making sure of a proper joint by soldering.

The input to the workshop is taken directly to the power board, described below, through another conduit, using lead sheathed cable with a capacity of about 20 A. This should be ample for most small workshops. There is one point here which requires special mention. Some authorities sell the electricity on two different rates, one for lighting and one for power, and great care must be exercised not to connect the input to the power board from either of these until first having consulted the electricity authority, or else one may find oneself facing charges of fraudulently using electricity for lighting and only paying at the lower rate for power.

My own workshop is also equipped with about three power points in various positions around the shed. These power points consist of a switch, two slydlock fuses and a socket mounted on a switch block and connected to the main board through the conduits already described. I would like to add that the sockets should all be of the same pattern and of the three-pin type, one pin being earthed to the conduit as described.

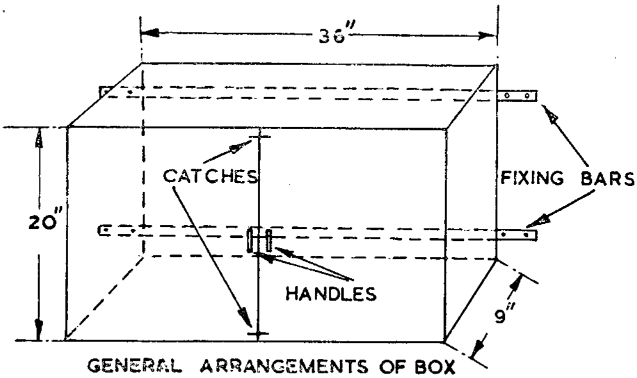
The Power Board

The power board really consists of a cupboard with two front opening doors. One door has all the items for 230 V mounted on it, and the other door is for other voltages. Personally I have motors for 110 V and 24 V, but each workshop will probably require other voltages depending on the equipment in use. The measurements for the cabinet are not critical and the ones I have quoted are merely the sizes I have found most useful. The depth of the cabinet should be great enough for all the transformers, etc. to be mounted inside.

Below is a sketch of the cabinet itself. The main body can be of wood, the sides of say 1 in. × 9 in. hardwood. The two doors consist of either 20 in. × 18 in. ffve-ply wood or, better still, plastic insulated board. The back can be left open if the board is to be mounted straight on to a wall or can be covered as desired. Mounting is effected by means of two 4 ft. lengths of 1 in. × ¼ in. steel bar fixed as shown.

The door on the left is for 230 V mains, but the equipment will be similar for other voltages. The suggested layout for the 230 V door is as shown on the left.

Item 1 consists of the main fusebox wired with 20 A fuses (30-s.w.g.). The input to the board is run into this box from the 18-way terminal box (Item 15) which is mounted inside the cubicle. From here the power is run through a 15 W pigmy bulb covered with a red glass (Item 2) into Item 3 which is a 0-25 A Ammeter.



GENERAL ARRANGEMENTS OF BOX

This is not essential, but it provides a guide to the current being drawn off the mains. The red pilot light which ensures that the master switch in the fuse box is not left on, should be connected in parallel across the fusebox, while the ammeter should be in series. The power is then run into the terminal box (16) mounted on the back of the panel. The terminal box, in my case, consists of an ex-Air Ministry type-box, and this is used to prevent a large number of wires having to be connected directly on to the ammeter. From these terminals output leads are taken direct to the other half of the board as shown in the tables below :—

TABLE OF CONNECTIONS TO 18-WAY TERMINAL BOARD

No.	From	To
1 2	Input from mains 230 V, a.c.	Main Fuse Box
3	Earth Input (from mains earth)	To earth terminals of sockets (Item 9
4	Earth Input (from term 3 above)	Earth Input socket on other panel
5 6	Terminals (Item 16)	Mains side of 110 V Transformer
7 8	” ”	Mains side of 24 V Transformer
9 10	” ”	Workshop Lights
11 12	” ”	No. 1 Bench Lights
13 14	” ”	No. 2 Bench Lights
15 16	” ”	Power Points
17 18	” ”	Spare

Also, from these terminals leads are taken to the five way switch block (ex-Government) and reading from left to right, the switches are for shed lights, bench No. 1 lights, spare, bench No. 2 lights, power points. The lead to this switch block can be common, but after this point separate wires must be run for each circuit. All the lights for the two benches and the shed are now run through fuses shown as item 6. Items 6 and 7 are two ex-Government four-way fuse boxes. From Item 6 the wires are run to their respective places on the terminal board. There is no need to fuse the output to the power points as each point is individually fused.

Next we come to the sockets and the wiring for these is taken direct from the terminals on Item 16, through a switch Item 8, and then through a fuse (Item 6 or 7) to the sockets Item 9, the two insulated terminals Item 11 and the bayonet type socket Item 10. The sockets (Item 9) should be of the standard three-pin type, and should all be the same as those fitted to the power points. The earth terminals from

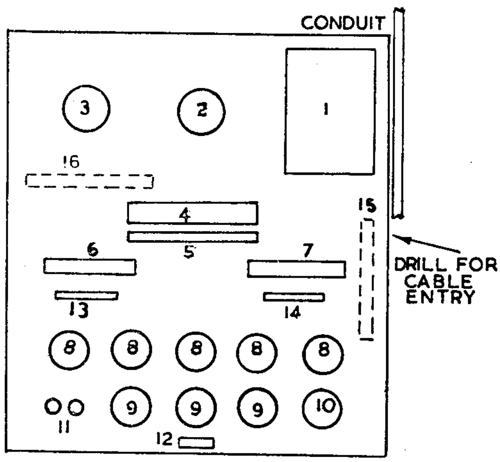


DIAGRAM OF RIGHT HAND DOOR (230 VOLTS)

these sockets should all be connected in series to the earth input (terminal No. 3). Items Nos. 5, 12, 13 and 14, are labels and should be inscribed as below :—

No. 5. Shed lights, No. 1 Bench lights, Spare, No. 2 Bench lights, Power Points.

No. 12. 230 V, 5 A, a.c.

No. 13. Shed lights, No. 1 Bench lights, No. 2 Bench lights, 230 V Terminals.

No. 14. 230 V socket, 230 V socket, 230 V socket, Bayonet socket.

My own labels were made of black traffolyte some time ago, but as some are now out of date, I am going to try to make some new ones as

described by Mr. W. J. Hughes (THE MODEL ENGINEER, 8th December, 1949).

It should be noted that the terminal board should be mounted on the back of the door panel itself so that the door can be opened fairly easily. This should also be borne in mind when connecting the input, etc. to the terminal block. My own input is run through conduit, which is connected to the side of the board as is the other conduit for the output for the lights, etc. The bayonet socket is fitted so that a bulb may be fitted if extra light is required on the board itself. By the judicious use of ex-Government equipment, a board of this type need not cost a great deal. My own cubicle has more than repaid its initial cost in the trouble saved.

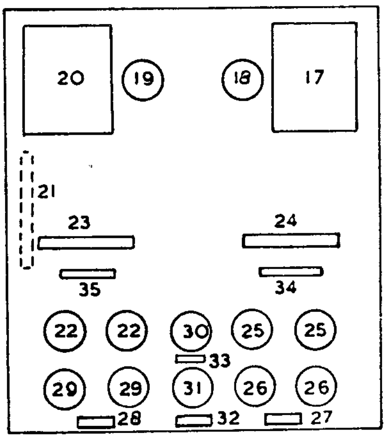


DIAGRAM OF LEFT HAND DOOR (110 & 24 VOLTS)

Owing to the number of fuses used, the main fuses have never yet blown on my own board. By fitting the switches on the main side of the fuse, it is possible to change any fuse without switching off the mains, provided the individual circuit is switched off. All the wiring on this board should be of heavy type, say 7.029 stranded copper wire, double rubber insulated, and connections to the terminals should be through soldered tags wherever possible. Both the 24 V and 110 V transfromers are situated in the cubicle itself, and the primary side is wired direct to the terminal board on the mains panel. The outputs from these transformers are led into the other panel.

The layout of the other panel is as shown in the accompanying sketch. Dealing with the 110 V circuit first. This is led in from the transformer through a 10-way terminal board (Item 21). From here it goes through a main switch and fuse to the 110 V lamp covered with a red glass (Item 18). Leads are then taken through the switches (Item 25) to the fuses on Item 24 (similar to Item 7 already described). From the fuses leads are taken to the 3-pin socket (Item 26) which *must* be of a different type to Item 9.

From the switch (Item 30) leads are also taken to the fuses (Item 24) which are used for the 110 V motor. The 24 V circuit is wired exactly similar to the above, using a switch (Item 31) for controlling the motor. The labels should read as follows :—

Item 28—24 V a.c.
,, 27—110 V a.c.
,, 33—110 V motor.
,, 32—24 V motor.
,, 35—24 V socket, 24 V socket, 24 V motor, Spare.
,, 34—110 V socket, 110 V socket, 110 V motor, spare.

All the sockets should be earthed as described for the previous board.

TABLE OF CONNECTIONS TO 10-WAY TERMINAL BOARD

No.	From	To
1 2	110 V Transformer	110 V Fuse Box
3 4	24 V Transformer	24 V Fuse Box
5	Earth	All sockets in series
6 7	110 V Fuse Box Fuses (Item 24)	110 V Motor
8 9	24 V Fuse Box Fuses (Item 23)	24 V Motor
10	Spare	

The second board can also be used to mount many other items. One of the most useful is a variable transformer of the "Variac" type, but unfortunately these are rather costly. Another improvement would be the fixing of variable resistances in both the motor leads in order to get a variable speed, but this again is costly, owing to the large current usually taken by motors of this type.

I am at the moment considering mounting a prepayment meter of the shilling-in-the-slot type on the side of the cubicle so that I may be entirely without blame for large electricity bills.

I sincerely hope that the foregoing may induce more of our readers to tidy up their power, and in this respect perhaps save a few frayed tempers in repairing fuses in the dark.

An Old Beam Engine

J. W. Grazebrook writes :—"As you are interested in the existence of old beam engines in various parts of the country, there is one in existence in the Dudley district. This engine has a date on it 1817, and is alleged to be one by Bolton & Watt. In view of your recent remarks as to the various contractors who worked for this firm, I am doubtful whether the engine was actually made by them. It cannot be traced in their records and there is no mark on it other than this date. The engine house in which it is situated is also of interest. This engine was working until three years ago on the cold blast iron furnaces of M. & W. Grazebrook Ltd., at Netherton. It has now been handed over to the City of Birmingham Museum and Art Gallery Committee."